Five Years After Rio: UNU's Responses to Agenda 21

Report presenting the work of UNU in response to Agenda 21.

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Contents

Forward

We are at a turning point in history. Our beautiful but vulnerable Earth has reached a point where it can no longer withstand the effects of human activity. Its survival now depends on the decisions we will make in the next few decades. For more than 20 years, the United Nations University has been providing decision makers with information that can be used to help develop more environmentally sustainable societies. And with the assistance of academics and practitioners worldwide, we have been seeking to bring environmental concerns towards the centre of economic policy-making. This report presents the work that we have done in response to Agenda 21. It provides an overview of our research and capacity-building efforts, and proposes a range of initiatives for responding to some of the planet's most pressing environmental problems.

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Introduction

The United Nations University (UNU) responded quickly to Agenda 21's action call by developing a 10-year programme on environmentally sustainable development. UNU decided that its programme would have three focal areas, reflecting the University's existing environmental research strengths. The first involves restructuring society towards sustainable development. The second is studying sustainable ways of managing natural resources. And the third is conducting activities on environmental governance and law. Since its implementation in 1993, UNU's response to Agenda 21 has helped promote environmentally sound development through research, capacity-building activities and dissemination programmes. UNU's autonomous platform within the UN system and its ability to work in close cooperation with governments, universities and the private sector has helped it find innovative solutions to some of Agenda 21's pressing problems. This report shows how UNU has turned Agenda 21's concerns into concrete actions by highlighting results from UNU studies undertaken.

Eco-Restructuring

Most of the world's environmental problems are caused by a failure or inadequacy of current development processes. Several of UNU's research activities are trying to find better ways of managing these processes ensuring that they are sustainable and that they revitalize growth.

Restructuring industry

Commercial activities are responsible, directly or indirectly, for most human impacts on the Earth's ecosystems. However, these activities are often conducted with little thought to their own sustainability: there will be no profits if the planet dies. Industries and businesses, therefore, have a strong self-interest in minimizing the ecological damage their activities cause. UNU has published two books on how industries and businesses can restructure toward sustainable development: *Industrial Metabolism: Restructuring for Sustainable Development and Steering Business Toward Sustainability*.

Industrial Metabolism: Restructuring for Sustainable Development, edited by Robert Ayres and Udo Simonis, is a comprehensive study on restructuring industry. It focuses on an economy's long-term technical transformation as demands on natural resources are reduced. The book begins with a description of industrial metabolism and its policy implications. Industrial restructuring is then examined in both developed and developing countries, followed by several illustrative case studies: chromium and lead pollution in Sweden, cadmium pollution in Europe's Rhine basin, and carbon monoxide and methane emissions in the United States. The last part of the book examines the future implications of industrial metabolism.

The researchers defined metabolism as the internal processes of a living organism and industrial metabolism as all the physical processes that convert raw materials and energy into finished products. The concept can be applied to manufacturing enterprises or, even more broadly, to nations and regions. Looking at industrial metabolism in this way reveals important policy implications. The industrial metabolism perspective considers all interactions between energy, materials and the environment. From this holistic perspective, it is easy to see that short-run, "quick-fix" environmental policies are likely to be harmful.

Steering Business Toward Sustainability, edited by Fritjof Capra and Gunter Pauli, outlines new approaches that business executives, economists and ecologists have devised for restructuring business toward sustainable development. For example, one business executive says that managers must take responsibility for re-educating themselves and their employees, especially as information on corporate environmental performance is being increasingly scrutinized by the media. A German civil servant describes how environmentally friendly firms are acquiring more political leverage. And an economist explains how ecologically based tax reforms can be used to stop companies from being rewarded for intensive resource use and pollution.

Both of these books respond to Agenda 21's chapter 30: *Strengthening the Role of Business and Industry*.

Reorienting production

UNU's Zero Emissions Research Initiative (UNU/ZERI) aims to invent waste-free manufacturing processes. When industries are clustered, the waste from one can become the input for another. In fact, to achieve environmentally sustainable development, industries must make use of each other's waste to the fullest extent possible. UNU/ZERI represents a new standard for industry where industries maximize the use of available materials, eliminating all emissions into air, water and soil. Industry representatives consider it to be the logical continuation of the zero-defects and zero-inventory challenges that they are pursuing in their Total Quality Management and just-in-time efforts.

UNU/ZERI has so far achieved several important goals. They have:

- reviewed a number of industries worldwide to find re-engineering opportunities;
- taken an inventory of manufacturing waste outputs;
- prepared output models which show the ideal way to cluster industries to achieve zero-emissions;
- identified technologies which will make these industrial clusters viable; and
- advised governments on how to design zero-emissions policies.

UNU has also organized two Zero Emissions Congresses. The first was held in 1995 at UNU Headquarters in Tokyo, Japan, and conducted simultaneously at sites in Asia, Europe and the United States via video connection on the Internet. The second Congress was held in 1996 at Chattanooga, Tennessee, United States. Four substantial zero-emissions commitments were obtained at the second Congress.

First, Sam Nujoma, President of Namibia, pledged one million Namibian dollars (US$250,000) to implement zero-emissions projects adjacent to a brewery in Tsumeb. Second, Abdul Rahman bin Ramli, President of Malaysia's Golden Hope, the largest palm oil plantation in the world, agreed to send his biologists to Latvia's world-renowned Wood Chemistry Research Institute for zero-emissions training. His biologists have now completed their training and are helping to design a zero-emissions palm oil processing facility which will be constructed near Kuala Lumpur. Third, the United Nations Development Programme (UNDP) will establish 10 ZERI chairs at 10 leading zero-emissions universities worldwide. Fourth, UNU will survey Japanese companies to determine their interest in zero-emissions concepts.

The University has also organized a series of 20-hour courses, introducing UNU/ZERI re-engineering concepts and methodologies to industries in Brazil, China, Colombia, Indonesia and Japan.

An urban future

Mankind's future is expected to unfold primarily in urban settings. The change of millennium will mark a divide from a predominantly rural world to one where most peoples will be living in cities. By the year 2000, there will be more than 400 cities in the world with over one million inhabitants. Of these, 28 will be mega-cities with populations exceeding eight million.1 And two-thirds of these mega-cities will be in developing countries. The management of these urban giants – the provision of shelter, services and a livelihood for their inhabitants in an

economically, socially and environmentally sustainable manner – will be a major challenge. UNU has published four books which will help urban planners restructure cities towards sustainable development: *Mega-city Growth and the Future, The Mega-city in Latin America, Emerging World Cities in Pacific Asia*, and *The Urban Challenge in Africa: Growth and Management of its Large Cities*.

In part one of *Mega-city Growth and the Future*, a group of leading scholars and planners from both developed and developing countries, and officials from the World Bank and the United Nation's Population Division, examine several demographic-related issues: labour force change in big Asian cities, the effects of macroeconomic forces on world cities, and the relations between technology and urban centres.

Part two is a discussion of the economic and social consequences of mega-city growth. Part three looks at the crucial issue of management of mega-cities, taking up such issues as infrastructure financing, land and shelter needs, transportation and environmental management. And the final chapter examines urban management issues in developing countries, deriving a research agenda for the 1990s. The researchers conclude that rapid urbanization in developing countries is neither a crisis nor a tragedy, but an opportunity to identify and implement innovative policies and programmes for socio-economic transformation. Because population distribution policies have not worked well, solutions to urban problems lie in effective city management.

Similar conclusions are reflected in *The Mega-city in Latin America*, edited by Alan Gilbert. First, the largest cities in this region differ greatly in their future prospects: it is far easier to be optimistic in Buenos Aires than in Lima. Second, whether urban problems improve or deteriorate has little to do with city size and a lot to do with larger economic and social trends. Third, Latin America's mega-cities are not going to grow to unmanageable proportions because their growth rates have generally slowed. Fourth, management is a critical issue for the future but it is difficult to know whether the quality of management will improve or deteriorate through time.

Emerging World Cities in Pacific Asia, edited by Fu-chen Lo and Yue-man Yeung, is a comprehensive appraisal of the interplay between global structural adjustments and the changing role and configuration of Asia's largest cities. In particular, Pacific Asian cities are examined as individual entities, in their regional setting, and then reexamined in the context of subregional cooperative development.

And *The Urban Challenge in Africa: Growth and Management of its Large Cities*, edited by Carole Rakodi, examines the growth of Africa's largest cities, studying each one's individual characteristics and evaluating the ways city planners have managed them. Africa is too often thought of as a place with vast empty spaces and impenetrable jungles. However, more than half of all Africans will live in urban areas within the next 25 years.

The UNU researchers who contributed to this book found that government policies have favoured cities to rural areas. The unfavourable terms of trade toward agricultural sectors have pushed peoples away from ravaged and environmentally degraded countryside areas to the cities. Researchers also found that African cities are dynamic: Africans are able to invigorate old institutions and even create new ones to cope with upcoming problems. UNU researchers reckon

that Africa's largest cities – even those in countries experiencing economic and state breakdown – will continue to grow and have vital economic roles for the continent in the future.

UNU and the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Management of Social Transformation (MOST) programme held workshops in both Hong Kong and Tokyo entitled "Globalization and Mega-city Development in Pacific Asia" in 1996. City planners and scholars were brought together to find solutions to the region's pressing urban problems. Participants from 10 Asian cities (Bangkok, Bombay, Hong Kong, Jakarta, Kanazawa, Manila, Seoul, Shanghai, Singapore and Tokyo) attended. The workshops had three important objectives.

The first objective was to analyse the impact of globalization on functional changes occurring in the region's cities. To do this, city planners were asked how they see globalization influencing their cities in the twenty-first century. In response, many said they must balance their residents' future urban needs with economic growth concerns. For example, Singapore's city-state government wants to balance urban development while trying to remain attractive to foreign investors. In Seoul, they are trying to harmonize quality-of-life concerns with development aspirations, as the city is transformed from an industrial to a post-industrial centre. And in the medium-sized Japanese city of Kanazawa, they struggle to balance cultural and economic development.

The second objective of these workshops was to generate more effective mega-city management and policy options. Participants agreed that long-term planning involving cooperation between central and local government authorities is important if their cities are to sustain their present rapid economic growth. The third objective was to create stronger links between urban planners and scholars.

In 1995, UNU and Finland's Ministry of Environment organized jointly a conference entitled "Human Settlements in the Changing Political and Economic Process." Sixty-two researchers and specialists from 32 countries attended. The purpose of the conference was to prepare academic contributions for the 1996 United Nations Conference on Human Settlements (Habitat II). Two publications were prepared prior to the conference and distributed within the UN system: The Urban Challenge and Habitat II and the Urban Economy (UNU/WIDER Research for Action Series Nos. 21 and 23).

All of this research responds to Agenda 21's chapter seven: *Promoting Sustainable Human Settlement Development*.

Reconciling economic growth and ecology

UNU researchers have identified several implications involved in reconciling society's economic growth needs, while at the same time preserving the environment.2 They came up with the following policy recommendations:

- A general prescription. Incentives to reduce the use of resources must be incorporated into all government policies.

- Poverty, population and the environment. Economic development that reduces poverty also protects the environment. Public health services, female education and the provision of rural infrastructure are necessary for protecting the environment in rural economies.
- Environmental effects and hidden export subsidies. Primary export products, such as timber or beef, often contain hidden subsidies which are paid for by the country's poorest people. These should be removed.
- Environmental accounting. New accounting systems need to be developed which incorporate environmental issues. The United Nations Statistical Office should be asked to develop such a system.
- Project appraisal. A comprehensive set of guidelines on project appraisal is needed, which contain techniques for valuing the environment. And all projects financed or managed by international organizations should be assessed for their environmental impact.
- Global environmental and international treaties. International greenhouse gas emission agreements will require substantial international resource transfers. Such transfers can be financed either by a carbon tax or by the distribution of emission rights as part of a system of transferable emission permits. It is not yet clear which of the two is likely to be the more effective system. This requires further study. One possibility is for the International Panel on Climate Change to explore the feasibility of both systems.
- Solutions to global environmental problems need international cooperation. Large monetary transfers to developing countries are necessary for achieving sustainable development. The best way of transferring these is as aid. In this way, developing countries become involved in a continuing policy dialogue with donors on policy reforms.

This work responds to Agenda 21's chapter eight: *Integrating Environment and Development into Decision-making*.

The cost of not acting

In *UNU/IAS Working Paper No. 9, The Cost of Inaction: Valuing the Economy-Wide Cost of Environmental Degradation in India,* Carter Brandon and Kirsten Hommann, economists in the World Bank Asia Environment Division, estimate that water and air pollution in India has economic and social costs of approximately US$7 billion per year. Land degradation and deforestation cost about US$2.7 billion. And these costs will increase unless environmental degradation stops. Consider the following policy and investment implications which they identified:

- The magnitude of environmental degradation in India is approximately 4.5 per cent of its gross domestic product (GDP) per year – more than enough to offset most of the country's annual growth, as reflected in national accounts. This shows that these growth measures are over-stated, especially because estimates would be even higher if such problems as toxic waste, biodiversity loss and the cost of clean water were included.
- The largest cost category is health, not productivity.
- Water degradation causes most of the countries health problems. Water degradation is more pervasive and demands more attention than the localized – albeit serious and worsening – problem of urban air pollution.

- Soil degradation is also a major problem, especially if annual crop yield losses are compounded 10 years into the future in a country with a rapidly growing population.
- Poor people benefit most from improved environmental management because they are buffered less from environmental impacts than the rich. This work responds to Agenda 21's chapter 8: Integrating Environment and Development into Decision-making.

Households are the key

Faye Duchin, a UNU researcher, has been studying households to help find solutions to ecological problems. Households make decisions about fertility and consumption – the key to structural changes affecting population growth and lifestyle. Her study has helped to articulate the social, environmental, and economic objectives of "reasonable people" by giving economics a more empirical, formalistic quality. Ms. Duchin created a conceptual and analytical household framework and tested it in Indonesia. Her framework is contained in a soon-to-be-published manuscript called *Household Lifestyles: the Social Dimension of Structural Economics*. It describes how people live and earn their livelihoods. And it shows how the lifestyles of different kinds of households change as Indonesia develops.

Her preliminary study is responding to Agenda 21's chapter four: *Changing Consumption Patterns*.

Technology can help

In *UNU/INTECH Working Paper No. 20, Sustainable Development by Substituting Technology for Energy and Environmental Constraints: Japan's View*, Chihiro Watanabe, a UNU researcher, reviewed Japan's success in overcoming natural resource scarcity with technological innovation and introduces the Japanese Ministry of International Trade and Industry's (MITI) comprehensive approach to sustainable development. His paper looks at pollution as a product of inefficiency: wasteful energy and material costs are seen as something that raises the price of doing business. Technology that provides a cleaner environment and a more efficient use of energy and materials is a way of increasing profits. By substituting technology, a potentially unlimited resource, for limited resources, Mr. Watanabe shows how Japan was able to improve productivity while maintaining sustainable development. His work responds to Agenda 21's chapter 34: *Transfer of Environmentally Sound Technology, Cooperation and Capacity-building*.

Energy and development

There are three factors driving globalization: energy, environment and economics. OPEC in the 1970s showed how the world's energy needs were interlinked. International concern for the environment has grown: between 1972-1992, the number of environmental treaties grew from a few dozen to more than 900. And international financiers, assisted by information and communications technology, can have a much larger impact on an economy than most governments.

UNU's publication, *Environment, Energy, and Economy: Strategies for Sustainability*, edited by Yoichi Kaya and Keiichi Yokobori, examines the interconnected links between these three factors

and development. Energy has long been recognized as a key to development. But it comes with high economic and environmental costs: many poor countries were hit hard by inflation caused by oil price shocks, incurred high foreign debt in order to pay for energy infrastructure, and suffer from serious fossil fuel-related environment and health problems. Yet they still have severe energy shortages.

Messrs. Kaya and Yokobori give three warnings. First, energy demands, and their associated environmental burdens, are likely to increase as developing countries industrialize. Second, carbon dioxide emissions (a by-product of this industrialization) will increase the risk of global warming. And third, an inevitable trade-off between energy and the environment is that deforestation and desertification will continue to threaten the planet's life-support systems. UNU has been involved in two other energy and development activities. One was the 1996 "High-level Expert Meeting on Solar Energy in East and South-East Asia," held in Akita, Japan. Participants attending this meeting discussed the latest technical progress that had been made in perfecting renewable energy technologies. Many of these technologies have now reached a pre-commercialization stage. The meeting's final programme and proceedings were compiled into a publication with the same title. The meeting was organized by UNU, UNESCO, the Japan Solar Energy Society, and the Akita Organizing Committee as one of the regional meetings leading up to the 1996 World Solar Summit.

The other energy and development activity is training. UNU's training and fellowship programme has three training courses for young professionals and researchers from developing countries on pollution-free energy sources. First, the UNU's "Geothermal Training Programme" based at Iceland's National Energy Authority, a UNU associated institution, has trained more than 200 fellows from developing countries on geothermal energy since 1979. Second, UNU's "Renewable Energy Systems" course, based at New Delhi's Indian Institute of Technology, has trained more than 60 fellows from 19 countries on utilizing energy from sources such as the sun or the wind. And third, in 1996 UNU conducted a three-week training course titled the "Tata Training Course on Energy, Environment, Resources and Sustainability." This course was organized jointly with the Tata Energy Research Institute in New Delhi, India, and examined sustainable development policies, programmes and practices that are relevant to India and its neighbouring countries.

This work responds to Agenda 21's chapter 35: *Science for Sustainable Development*.

Constrained income growth

Mih'ly Simai and several other UNU researchers contributed to a special issue of the journal *World Development*. Their contribution, "Sustainable Development: Macroeconomic, Environmental and Political Dimensions," dealt with the complex and troublesome problems of how to sustain equitable income growth, subject to three constraints: economic, political and environmental. These three constraints were analysed in 11 countries: Argentina, Brazil, Chile, China, India, Mexico, Nicaragua, Philippines, Russia, Turkey and Zimbabwe. Their analysis had the several important conclusions.

First, improved environmental policy alone was not enough to achieve sustainability: the shortcomings of economic, political and environmental policies enhanced and reinforced each other. This suggests that there is a strong correlation between the so-called development and ecological crises. Second, poverty and environmental degradation are closely linked. And third, the contradiction between economic growth and environmental sustainability is not simply a consequence of growth patterns and macroeconomic policies, but is also caused by corporate interests and individual behaviour.

This work responds to Agenda 21's chapter 4: *Changing Consumption Patterns*.

Combining development with disaster prevention

UNU has been investigating ways to combine sustainable development with industrial disaster preparation. In particular, UNU has two objectives: to learn from previous industrial disasters in the hope of preventing them in the future; and to understand how communities respond to and recover from them. The results of this study are contained a book edited by James K. Mitchell entitled *The Long Road to Recovery: Community Responses to Industrial Hazards*.

The seven disasters analysed in this volume were all either highly publicized industrial accidents or destruction caused by war. They are: the mercury contamination in Minamata, Japan; the underground fires in Centralia, Pennsylvania, United States; the air-borne dioxin release at Seveso, Italy; the poison gas cloud in Bhopal, India; the nuclear reactor fire at Chernobyl, Ukraine; the *Exxon Valdez* oil spill in Alaska, United States; and the destruction of Iran's oil facilities during its war with Iraq.

The study had four recommendations. First, there is a need for more empirical research on how communities recover from industrial disasters. Second, a system of long-term post-disaster assessments should be institutionalized wherever possible. Third, individuals, communities and institutions should be encouraged to exchange with others their industrial disaster experiences. And fourth, researchers studying industrial disasters need to expand their investigations so that they come up with more ways for communities to successfully cope with them.

The 10 contributors to this book call for a new system for conceptualizing and managing industrial hazards and disasters. And they stress the need for long-term post-disaster assessment and the creation of information clearing-houses that focus on industrial disasters.

UNU has two additional activities in this area. First, UNU has initiated the development of GLO-DISNET, an Internet-based site with information from more than 80 countries on hazardous risk management strategies. Its objective is to initiate and implement programmes that reduce the risks of environmental damage and human suffering during a natural disaster. And second, UNU is helping other universities put on disaster prevention-related training courses, such as its "Training Course on the Analysis and Management of Geological Risks," that is held annually at the University of Geneva in Switzerland.

This work responds to Agenda 21's chapters 19-22.

Managing Natural Resources

UNU's work is examining sustainable ways of managing natural resources, especially their ability to support, resist, or recuperate from change.

People, land management and environmental change

UNU has a large project called "People, Land Management and Environmental Change" (UNU/PLEC). UNU/PLEC is a demonstration and capacity-building project concerned with conserving biological diversity in managed agricultural ecosystems. It responds directly to Agenda 21's chapter 15: *Conservation of Biological Diversity*.

The project recently got off the ground after having attracted over six million dollars in funding from the Global Environment Facility (GEF). GEF and the majority of other environmental organizations recognize that most of the world's plant biodiversity lies in cultivated and semi-cultivated lands in the tropics and subtropics – an area many times larger than can be effectively protected through government controls. During the last 50 years, however, significant numbers of cultivated plant varieties and landraces have disappeared because of the commercialization and mechanization of agriculture. In contrast, many of the areas where highly diverse plant species and genetic varieties still exist are managed by farmers and pastoralists whose systems share several common characteristics: diversity in cropping and cultivation, micro-level adaptations, successional vegetation and small-scale farming. Even as populations grew and markets expanded, indigenous knowledge systems were applied in farms which combined commercial and intensive production with adaptive techniques, such as integrated pest management and organic methods for maintaining soil fertility and land quality. There is a need to document these approaches systematically and to evaluate their viability in the light of the pressing demand for increasing food production. It is necessary to determine the range of conservation strategies to be used and provide the appropriate support to communities in agroecosystems where biodiversity is at risk.

This is what UNU/PLEC aims to do: focus on agricultural lands located in priority ecosystems that are managed by farmers and pastoralists. These are lands that are at the margins of forests, semi-arid regions, mountains, wetlands and land corridors.

UNU/PLEC works through locally-based "clusters" which have been established in seven areas: West Africa (Ghana and Guinea); East Africa (Kenya, Tanzania and Uganda); South-East Asia (Yunnan Province of China and northern Thailand); Papua New Guinea; Mexico; Jamaica; and Amazonia (Brazil and Peru). The UNU/PLEC network includes approximately 100 scholars, most of whom come from participating developing countries. This provides UNU/PLEC with an innovative South-South cooperation network, enabling researchers in Latin America, the Caribbean, Africa and Asia to communicate easily, exchange information, and learn from each other.

UNU/PLEC's work started prior to the funding it received from GEF, using UNU's own resources. Field work has been undertaken and meetings have been held. Their results are reported in several publications. One such publication is Population, Land Management, and Environmental Change. This book, edited by Juha Uitto and Akiko Ono, emphasizes the importance of participatory approaches to agricultural development involving sustainable land management and preservation of biodiversity. Their findings question the traditional role of outside experts, researchers and aid professionals, instead placing emphasis on the farmers own knowledge that had been adapted to the local conditions over decades of sometimes rapid change.

Research under the UNU/PLEC West Africa cluster has focused on the rich biological resources and the time-tested indigenous systems of managing them have increasingly come under pressure from several societal forces: population growth, social change, migration, shifts to cash cropping and government policies. UNU researchers published the results of their preliminary field work in a publication entitled *Environment, Biodiversity, and Agricultural Change in West Africa*. In this book, edited by Edwin Gyasi and Juha Uitto, the researchers emphasize the value of indigenous practices and their ability to adapt rapidly to changing conditions. The researchers believe that these local practices hold the key to the region's sustainable development. UNU researchers examined several problems that are holding back agricultural sustainability. They argue that a bias against subsistence agriculture – overlooking the fact that two-thirds of all Africans live on subsistence farming – has damaged Africa's ability to feed itself. Farmers have acquired centuries of knowledge that has helped preserve both environmental integrity and biodiversity. The researchers conclude that the resiliency fostered in local agricultural practices can keep land from degrading and help to protect biodiversity.

UNU/PLEC research results and methodological developments are also disseminated through more rapid means than by producing books. An important channel is the project's periodical *PLEC News and Views*, which has now appeared in eight issues. Also a special issue of the journal *Global Environmental Change: Human and Policy Dimensions* was produced focusing on UNU/PLEC and edited by the project's Scientific Coordinator, Harold Brookfield.

Regions at risk

UNU has examined nine cases in which large-scale human-induced environmental change threatened to destroy an ecosystem. The results of these examinations have been published in four volumes: *Regions at Risk: Comparisons of Threatened Environments, In Place of the Forest: Environmental and Socio-economic Transformation in Borneo and the Eastern Malay Peninsula, Amazonia: Resiliency* and *Dynamism of the Land and Its People, and The Fragile Tropics of Latin America*.

Regions at Risk: Comparisons of Threatened Environments, edited by Jeanne Kasperson, Roger Kasperson and B.L. Turner II, is the end result of a joint UNU, Clark University and the International Geographic Union study on geographic areas that scientists consider to be "critical regions", regions that are particularly vulnerable to or suffer from extreme environmental degradation. The study examined nine such regions: the Amazon, the Aral Sea basin, the middle mountains of Nepal, Kenya's Ukambani region, the US Southern High Plains, the Mexico basin,

the North Sea, China's Ordos Plateau, and South-East Asia's eastern Sundaland region. Their investigation was divided into two parts.

In the first part, researchers proposed formal definitions for two concepts: environmental criticality and endangerment. Then in the second part, these concepts were converted into the physical and social realities of each region. These case studies make available an up-to-date synthesis of vast amounts of previously inaccessible data and, as such, will be valuable to interested scholars and policy makers.

In Place of the Forest: Environmental and Socio-economic Transformation in Borneo and the Eastern Malay Peninsula, by Harold Brookfield, Lesley Potter and Yvonne Byron, describes how massive deforestation has transformed this region from a rich ecosystem into an "environmentally critical" area. Their book begins with a description of the area's natural environment and then reviews the environmental destruction that has occurred since World War II.

The region has been considered as a resource frontier for decades. And this thinking is likely to continue as it has become a major source of energy. The authors studied the long-term consequences that human activities are having on the area's environment. They had some significant findings.

They found that the region is a complex mosaic of problems occurring in sub-areas. The region as a whole cannot be understood without understanding these problems. For example, most deforestation there can be traced to the international demand for the region's resources. The researchers also found that the region has not yet reached a critical point (although some areas have experienced considerable damage). But they admit considerable uncertainty clouds its future. They believe national policies that continue to treat the areas as resource frontiers – despite the fact that resources are actually becoming scarce – are the greatest danger.

Amazonia: Resiliency and Dynamism of the Land and Its People, written by Nigel Smith, Adilson Serro, Paulo Alvim and Italo Falesi, examines the forces behind the Amazon's rapid ecological and socio-economic changes, considering current threats to its forests.

The title reflects the book's main message: that despite extensive environmental degradation, the Amazon can bounce back. The authors arrive at this conclusion after analysing five change-inducing forces (population, new technologies, socio-economic conditions, attitudes and income) that interact with and alter its physical, social and cultural environments. Their research shows that deforestation in the Amazon is less widespread than many claim and that much of the damage is concentrated in specific areas.

The authors remain hopeful that the Amazon can be developed in a sustainable way.

The Fragile Tropics of Latin America, edited by Toshie Nishizawa and Juha Uitto, is about the region's biggest environmental dilemma: how to use its natural resources in ways that do not destroy the fragile tropical ecosystems. The book explores several areas of concern: human-

induced changes in the tropics; interactions between tropical and non-tropical regions; and sustainable technological, cultural, and land-tenure strategies that work well in the tropics.

This research responds to Agenda 21's chapters 10-15.

Mountains

UNU is active in the so-called Mountain Agenda an informal group of academics and development professionals with special interests in sustainable mountain development. The group had been trying to get mountain issues onto the global environmental agenda long before the United Nations Conference on Environment and Development (UNCED) was held in Rio de Janeiro in 1992. As a result, UNU researchers played a key role in drafting Agenda 21's chapter 13: *Managing Fragile Ecosystems: Sustainable Mountain Development*.

Mountains occupy about one-fifth of the Earth's land surface and are home to one-tenth of the world's population. However, their resources – water, electricity, minerals, timber, tourist havens, recreation and religious inspiration – are used by more than half of the peoples on the planet.

Since the Rio conference, UNU has participated in the UN inter-agency and NGO follow-up process to Agenda 21's chapter 13, and has become the lead agency for research. As a result, the book *Mountains of the World: A Global Priority*, edited by Jack Ives and Bruno Messerli, along with a related policy document were prepared as contributions to the United Nations General Assembly Special Session five years after the Earth Summit. These comprehensive works were carried out as a collaborative effort between UNU, the Swiss Development Cooperation, UNESCO, FAO and the International Development Research Centre/International Potato Centre.

In the Himalayan region, UNU researchers are working on a project on Floods in Bangladesh: Processes and Impacts. They are attempting to unravel the complex interlinkages between flooding in Bangladesh and erosion and deforestation in the Himalayas. Conventional theory links the post-1950s population explosion in the Himalayas with deforestation and soil erosion in the mountains, and massive destruction downstream. However, Messrs. Ives and Messerli argue that many of the assumptions behind this theory are invalid. In their path-breaking study *The Himalayan Dilemma: Reconciling Development and Conservation*, they approached the problem from a deeper historical perspective and concluded that much of the deforestation had already occurred hundreds of years ago. The damage was aggravated further by two centuries of environmentally-unfriendly development policies under colonial rule. They also found that mountain subsistence farmers are not the cause of this problem, but are instead a key to its solution.

A major achievement of UNU's long-standing work on Mountain Ecology and Sustainable Development has been in the field of capacity-building and networking. UNU was instrumental in setting up the African Mountain Association (AMA) to promote research and development activities for environmentally sound use of mountain resources by local scholars and practitioners. All four AMA workshops held to date have been organized with UNU support. The latest was held in the spring of 1997 in Madagascar. It had the theme: "African Mountain Development in a Changing Economic World."

UNU also helped organize two regional workshops in the Andean region. Several training activities have been linked to these workshops and the networks they have formed are good for capacity building.

The journal *Mountain Research and Development* – already in its seventeenth volume under the leadership of UNU and the International Mountain Society (IMS) – continues to be the leading channel for publishing scientific articles concerned with highland-lowland interactions and their sustainable development.

Water and health

UNU created its Canadian-based Programme, International Network on Water, Environment and Health (UNU/INWEH) to help respond to Agenda 21's chapter 18: *Protection of the Quality and Supply of Freshwater Resources*. UNU/INWEH is integrating international expertise into a programme of education, training, research, and technology transfer on major water, environment and human health issues. Its work is project-based, with researchers proactively responding to global water problems with innovative solutions. The programme has several water-related themes: protection and management, wastewater treatment, environmental assessment, eco-toxicology and human health impacts. This work is being carried out through networks and project teams around the world.

One unhealthy body of water which UNU researchers have studied is the Aral Sea. This was once the world's largest lake. Now it is close to disappearing. Under the planned economy of the former Soviet Union, the region around the lake was to become a model production centre for cotton and rice. Instead, as a result of mismanagement and large-scale irrigation projects, salt and toxic dust now blow from the dried lake bed, threatening the region's agriculture and its 35 million inhabitants.

In 1992 and again in 1994, UNU and Japan's Global Infrastructure Fund Research Foundation held two international symposia on the Aral Sea and surrounding regions. The results of these symposia were published into two booklets entitled *Environmental Management of the Aral Sea Region* and *Report of the Seminar on the Aral Crisis*. The first symposium was particularly interesting because environment ministers from the five republics surrounding the sea were invited to speak on ways of solving the region's environmental problems. And UNU was successful in persuading the ministers to sign two important resolutions: a declaration that the Aral Sea Basin be designated an International Critical Environmental Zone and a request for international assistance to help salvage it.

Safeguarding the soil

The misuse of soil and inappropriate agricultural systems are causing serious environmental degradation in the humid tropics. This perpetuates food shortages, under-nutrition and poor living standards. To help stop this, UNU has been studying ways of making agricultural systems in the tropics more sustainable. In particular, UNU researchers are trying to prevent soil erosion and the depletion of soil fertility in these systems. They have written two helpful books on the

subject: *Agroforestry in the Pacific Islands: Systems for Sustainability* and *Sustainable Management of Soil Resources in the Humid Tropics*.

Agroforestry in the Pacific Islands: Systems for Sustainability, edited by William Clark and Randolph Thaman, is the outcome of a UNU study that examined several thousand-year-old agroforestry systems in the Pacific Islands. The purpose of the study was to compare agroforestry systems practiced on several different islands. The book shows how agroforestry systems have contributed to environmental stability while at the same time providing food for Pacific Island societies. The contributors believe agroforestry benefits Pacific Islanders, but recognize that there are costs and disadvantages involved with it. They argue that the Islanders' thousand-year-old systems should not be replaced by new systems and plants, but that they should be protected and used in forestry, agricultural and agroforestry development projects worldwide. This volume responds to two Agenda 21 chapters: chapter 11 (*Combating Deforestation*) and chapter 14 (*Promoting Sustainable Agriculture and Rural Development*).

And Rattan Lal's *Sustainable Management of Soil Resources in the Humid Tropics* outlines several innovative options for managing soil in such areas. His research shows that substantial increases in crop production would be possible if improved tree cutting, soil nutrient management and agroforestry systems were adopted. He believes that if land is to be deforested, it should be done either by using hand held tools or by shear-blade cutting methods, followed by in situ burning. The cleared area should then be sown quickly with an appropriate crop to keep the ground covered. And soil erosion measures, such as planting vegetative hedges around the perimeter, should be done quickly.

Nutrient recycling is important for the humid tropics' low fertility soils so that nutrient losses can be reduced without using harmful chemical fertilizers. This can be done by allowing nutrient-rich crop residues and other organic wastes to return to the soil.

The study shows that agroforestry systems are also important for controlling soil erosion and recycling nutrients. There are several tree species with high net biomass production that are efficient in recycling nutrients from the sub-soil horizons. The prunings and foliage alone from these trees may add 100 to 800 kilograms of nutrients per hectare to the soil each year. With proper management, 20 to 30 per cent of these nutrients can be used for crop production. Synergistic effects are achieved if supplemental doses of chemical fertilizers are used along with these organic residues and prunings.

Each hectare of already cleared land that uses these improved methods saves several hectares of tropical forest from deforestation.

This research responds to Agenda 21's chapter 10: *Integrated Approaches to the Planning and Management of Land Resources*.

Forests

UNU researchers are analysing forestry resources worldwide to determine two things: the concept of forests as greenhouse gas sinks and the role forests can play in the international convention on climate change. They have so far had three accomplishments.

First, they studied deforestation rates in 90 tropical countries and have completed an econometric analysis of deforestation in the Amazon. Second, they have made good progress in creating a dynamic model which shows clearly the Amazon's deforestation. And third, they have observed some of the effects deforestation has had on carbon dioxide emissions levels. UNU is working with the Finnish Forestry Research Institute, the European Forest Institute and Brazil's Instituto de Pesquisa Econmica Aplicada on the project.

The project's results are being compiled into a book. There are four things that this compilation will try to accomplish: explain the transition from deforestation towards sustainable forest management, give short and long range forest change and carbon flux scenarios for both hemispheres, evaluate the effectiveness and cost efficiency of different forestry management options which would both help remove CO2 from the atmosphere and slow down deforestation, and discuss tradable CO2 permits as a way of promoting North-South environmental cooperation.

This study responds to Agenda 21's chapter 11: *Combating Deforestation*.

Africa's resources

UNU has a research and training centre based in Ghana, called the Institute for Natural Resources in Africa (UNU/INRA). This institute is devoted to assisting African countries in implementing Agenda 21. In its initial work, it has sought to address the continent's urgent needs for human resource development and institutional capacity building by assessing the research capabilities of African universities and research institutions, conducting field surveys on the continent's natural resources, and determining the feasibility of setting up its own research facilities in relation to existing laboratories in its host country.

Thirty university campuses and research institutes in 20 countries were visited to determine their potential to carry out research and training. Four conclusions came out of these visits. First, the research and training already being done in basic science subjects (such as biology or chemistry) had not been integrated into an overall natural resource conservation and management programme. Second, declining levels of university funding and low financial remuneration has led to the so-called brain drain of university staff. Third, universities remain isolated from research institutes. And fourth, none of the universities surveyed offered courses in environmental education, ecological economics, natural resource economics, or environmental law, all of which are necessary for successfully implementing Agenda 21.

Field surveys have been conducted under the following headings: Soil and Water Resources, Indigenous African Food Crops and Useful Plants, and the Status of Mineral Resources. The Soil and Water Resource surveys showed that the highly weathered, low fertility soils of tropical

Africa are becoming increasingly degraded and are declining in productivity because of over cultivation (caused by a growing human population). It was obvious from the surveys that integrated land use plans and comprehensive soil conservation programmes were not being developed. In fact, very little research was being done by African universities on the subject. Water Resource surveys showed similar results: little ongoing research of limited scope.

The Indigenous African Food Crops and Useful Plants surveys showed that indigenous African food crops were being neglected: Africans were not cultivating, using, or conserving them. They were paying more attention to non-indigenous staple foods. Also, very little indigenous germ-plasm material was being studied or conserved in the continent on a routine basis. And since the 1960s, little has been documented on indigenous food uses and their ethnobotanical importance. The Status of Mineral Resources surveys indicated a serious deficiency in trained mineral exploration personnel and limited capacities for creating appropriate small-scale mining technologies. There were also deficiencies in policies, laws and the mineral-based manufacturing that support mining. And African governments did not appear to be searching for ways of rehabilitating the environmentally damaged mining sites that are causing extensive pollution.

The Institute conducted a feasibility study for the development of a reference pedalogical facility that will include a soil, plant and water analysis laboratory. This facility, to be developed in cooperation with Ghana's Council for Scientific and Industrial Research (CSIR), would be used for research, training and dissemination on resource conservation.

UNU researchers, under the direction of Jean Nzisabira, have examined the condition of Zaire's threatened environmental sites. They also reviewed relevant institutional actors involved in the system of land-use and territory development. Their main conclusion is that the socio-economic and environmental crisis in Zaire reflects a malfunctioning of the country's technological capacity-building process, which from colonization to now, is being implemented through transfer models with objectives in conflict to the real needs of Zaire's people.

Sustainable futures

UNU researchers have studied several of the driving forces that are causing changes in two regions: Asia and Africa. These change-inducing forces include population growth, urbanization, industrialization, and the resulting environmental degradation. The researchers have compiled their results into two books: South-East Asia's Environmental Future: The Search for Sustainability and Sustaining the Future: Economic, Social, and Environmental Change in Sub-Saharan Africa.

In *South-East Asia's Environmental Future: The Search for Sustainability*, edited by Harold Brookfield and Yvonne Byron, the researchers studied climate uncertainties, deforestation, sustainability of food production, deteriorating urban and marine environments, and institutional problems which obstruct better environmental management. They found that an important change is taking place in South-East Asia: the region no longer has the abundance of natural resources it once had. Its growing population is rapidly using them up. A perception of resource limitations is now becoming widespread, though perhaps not yet in economic sectors. UNU researchers reckon that within a few years government development planning will be conducted

with resource scarcity in mind. And they hope that this moves them quickly towards a mentality of careful resource management. Such a change, they argue, is essential for a more sustainable future.

The number of environmentally aware scientists in South-East Asia is increasing, but public and official awareness of environmental deterioration and resource exhaustion has not yet reached a level where a strong political will for improved environmental management exists. Population growth and a drive for ever faster development are two major barriers to achieving sustainability. It will take at least another generation before the region's population growth rate can be stabilized. In contrast, the researchers think reorienting growth attitudes is possible in a much shorter time, citing Singapore as an example.

As the most developed part of the humid tropics, South-East Asia has a growing responsibility to lead the way towards a more sustainable form of development. UNU researchers believe the greatest hope for future sustainability lies in growing environmental awareness. Public opinion can change faster than population growth rates. And there are signs that a widespread and lively sense of environmental responsibility may evolve quickly in the region. If this happens, South-East Asia will be on the road towards achieving sustainable development.

And in 1993, UNU held a conference titled "Sustainable Environmental and Management Futures for Sub-Saharan Africa" in Accra, Ghana. The objective of the conference was to explore ways of getting the region on track to sustainable environmental and resource management within 20 years. UNU's publication, *Sustaining the Future: Economic, Social, and Environmental Change in Sub-Saharan Africa*, edited by George Benneh, William Morgan and Juha Uitto, came out of this conference.

The contributors to this book discuss sustainable development and resource management in the region for the next 20 years. In the first part they analyse the causes of environmental change in the region: persistent poverty, population growth, urbanization, industrialization, and energy production and consumption. In the second part they examine issues central to sustainability, such as agriculture, on which most peoples still depend for their livelihood.

In conclusion, the contributors stress the need for poverty eradication policies and equitable economic development to counter unsustainable natural resource use and to reduce vulnerability to environmental deterioration, economic decline and hazards. They think that more cooperation is needed to improve resource management between the North and the South, especially on issues such as trade. They also recommend that Sub-Saharan Africa strengthen both its environmental institutions and environmental education.

Small islands

Small island communities are the custodians of much of the Earth's marine environment. The challenge is to ensure that these areas are developed and used in an environmentally sustainable way. To help, UNU has developed a Small Islands Network and an island networking database. The Network is improving the quality and amount of environmental information available to small island countries. The network is Internet-based, at http://sunsite.sut.ac.jp/island/

gateway.html, and is located at a joint UNU-Environment Agency of Japan initiative called the Global Environment Information Centre (GEIC), located at the UNU Headquarters in Tokyo.

UNU researchers wrote several papers in preparation for the 1994 Global Conference on Sustainable Development of Small Island Developing States, held in Barbados. The papers studied several important small island state issues: finding alternative energy sources, tourism, natural disaster management, and the capabilities of the Caribbean Meteorological Organization and the Caribbean Disaster Emergency Response Agency. The papers were compiled into *UNU/ WIDER World Development Studies No. 1, Small Islands, Big Issues: Crucial Issues in the Sustainable Development of Small Developing Islands*. A Programme of Action promoting responses to small island problems was developed at the Conference and subsequently adopted by the international community.

As a follow-up to the conference, in 1995, UNU and Japan's National Land Agency organized the "International Symposium on Small Islands and Sustainable Development" to discuss the following topics in a small island context: eco-tourism, urban development and the environment. A report in English and Japanese containing the symposium's proceedings was published with the same title. This research responds to Agenda 21's chapter 26: *Recognizing and Strengthening the Role of Indigenous People and Their Communities*.

Constraints

V. Bhaskar, Andrew Glyn and several other UNU researchers have analysed the impact of environmental constraints on the patterns of development around the world. Their results are summarized in *The North, the South, and the Environment: Ecological Constraints and the Global Economy*. Current inequalities in the distribution of income, resource use and consumption mean that constraints will have very different implications around the world. Experts from both hemispheres assessed and compiled into this book the kinds of economic institutions, government policies and international arrangements which are needed in order to achieve sustainable development worldwide. **Environmental fora**
UNU has held six Global Environmental Fora to allow scientists from around the world to present their latest research findings and to make the public more aware of environmental problems. The fora are sponsored by Japan's Obayashi Corporation and have been held annually since 1991 in either Tokyo or Osaka.

The first was titled "Monitoring and Action for the Earth." It focused on technological monitoring methods and more reliable ways of gathering environmental information.

The second was called "Environmental Change in Rain Forests and Drylands." It dealt with localized environmental deterioration in tropical and subtropical areas. The third was focused around a question: "Will Tropical Forests Change in a Global Greenhouse?" It examined the links between global warming and the sustainability of tropical rainforests.

The fourth was titled "Population, Land Management and Environmental Change." It focused on problems common to small-scale farmers, such as population growth. The United Nations Environment Programme (UNEP) helped organize this forum.

The fifth was called "Freshwater Resources in Arid Lands." It focused on more economical ways to use water. UNEP also helped organize this forum.

The sixth, held in 1997, was called Water for Urban Areas in the Twenty-first Century. It focused on sustainable water supplies for cities.

Environmental governance

UNU is studying ways to improve the mechanisms which govern the environment and development. Governance in this instance means the ways in which sustainable development is managed at local, national and global levels. It involves creating new eco-friendly values, laws and institutions. UNU is acting as a catalyst in making these changes happen.

Developing and teaching environmental law

UNU has helped develop environmental law for several years. Its first publication on the topic, written by Edith Brown Weiss, was *In Fairness to Future Generations: International Law, Common Patrimony, and Intergenerational Equity*. After this ground-breaking book was written (which has since been translated into several languages), the University decided it would focus on training university faculty worldwide in environmental law. To do this, UNU is developing the *UNU Training Manual in the Teaching of International Environmental Law,* the first such publication of its kind. This manual includes everything teachers need: course material, books, lecture notes and exercises. UNU has been using it to train young faculty members at universities in more than 20 countries including Argentina, Brazil, Chile, China, Croatia, Fiji, Ghana, India, Indonesia, Japan, Kenya, Republic of Korea, Malaysia, Philippines, Russia, Singapore, South Africa, Spain, Thailand and Viet Nam.

UNU has published another book on the topic, *Environmental Change and International Law: New Challenges and Dimensions*. This publication edited by Edith Brown Weiss, is all about the changing role of international environmental law.

All of these teaching materials were used in three UNU-organized environmental law training courses. The first was the 1995 "UNU Global Faculty Training Workshop on International Environmental Law," held in Barcelona, Spain. The second, also held in 1995, was the "UNU East Asian Faculty Training Workshop on International Environmental Law," held in Tokyo, Japan. And the third course was the 1997 "Teaching Environmental Law at the University Level," held in Singapore. UNU helped organize this course along with three other organizations: the Asia-Pacific Centre for Environmental Law, UNEP and the International Union for the Conservation of Nature (IUCN).

As a result of this training, courses on international law have been established in Argentina, Brazil, China, Ghana, Kenya, Malaysia, Namibia, Russia and Viet Nam. And more than 3,500 students from 30 countries are being trained annually in environmental law with UNU teacher training materials.

Conducting these courses has also helped UNU strengthen its relationship with other organizations, such as UNEP, IUCN, South Pacific Regional Environment Programme (SPREP), United Nations Institute for Training and Research (UNITAR) and the Asia Pacific Centre for Environmental Law (APCEL).

This work responds to Agenda 21's chapter 39: *International Legal Instruments and Mechanisms*.

Enforcing environmental law

In *UNU/INTECH Working Paper No. 19, Enforcement Issues for Environmental Legislation in Developing Countries*, Michael Faure, a UNU researcher, tried to determine if the principles that Western environmental legislation is based on can be applied directly to developing countries, or if these principles must be adapted to suit local circumstances. He found three insightful results.

First, countries that are just beginning to develop environmental legislation do benefit from the experience of Western countries. However, experience from the European Union suggests that environmental standards must be made to reflect local conditions and varying public preferences. Copying legislation directly from developed countries is not recommended.

Second, environmental legislation must be able to address real problems: broad legislation that does not have adequate licensing or standard-setting provisions is not effective. Laws must be based on a legal framework that defines clearly the level at which the environmental standards were made and who is responsible for making decisions when protection and development issues collide.

Third, corruption in many countries hampers the enforcement of environmental law. Such laws are effective only when they are enforced by an independent judiciary. However, research in several Latin American countries shows that enforcing environmental statutes can also be done by granting standing rights to environmental groups as a counterweight to industrial lobbying or government corruption.

And UNU has also focused on the enforcement of environmental law. In 1997 UNU organized a public forum at its Headquarters titled "Engaging Countries: Strengthening Compliance with International Environmental Agreements." Two UNU researchers, Harold Jacobson and Edith Brown Weiss, discussed the results of their study on what 10 countries had done towards implementing and complying with five environmental agreements.3

This work responds to Agenda 21's chapter 39: *International Legal Instruments and Mechanisms*.

Implementing environmental accords

UNU researchers have been trying to find out more about the implementation process of environmental accords. They have gone about studying them in two ways.

First, UNU and Dartmouth University's Institute for International Environmental Governance (IIGE) organized a workshop titled "Implementation of Environmental Accords." The purpose of the 1994 workshop was to discuss the status, methodology and strategy that future research on this topic would take and stimulate scholars' interest in it. Then in 1995, Universitat de Pompeu Fabra in Barcelona, Spain, organized a public lecture series on environmental law.

And second, to learn how individual countries go about implementing these accords, Yvonne Ruijters, a UNU researcher, conducted a study on environmental legislation and technology in Mexico. The study tried to uncover two things. First, it tried to find out if corporate behaviour was influenced by Mexico's environmental legislation. Second, it tried to determine if environmental legislation, when properly enforced, increased the demand for environmentally sound technologies. Mexico was the country chosen for the study because it has relatively advanced environmental legislation and its authorities are serious about enforcing it.

Extensive interviews were conducted with both Mexican-owned and multinational companies operating in Mexico City.4 The Mexican companies said that once they realized the authorities were serious about enforcement, they quickly started finding out what environmental standards were applicable and what they were required to do to meet them. Environmental consultancy in the country boomed when the authorities cracked down. And the market for environmental products expanded rapidly. The government's law enforcing actions also stimulated domestic research on environmental technology, as there was a strong demand for technology which fit Mexico's unique conditions.

All the multinational companies interviewed said they had taken steps to improve environmental conditions at their facilities based on Mexico's laws and that they had brought environmentally sound technology into the country when they initially set up their facilities.

This work also relates to Agenda 21's chapter 39.

A new textbook

UNU has produced a textbook titled *Economic Analysis of Environment and Development*. UNU hopes that adding this book along with environmental economics courses to developing-country universities will improve students' knowledge on the subject and encourage more research. UNU also hopes that it will sensitize local decision makers to environmental issues.

The textbook has so far been used to teach young economics lecturers in developing countries at UNU's three Training Workshops in Environmental Economics. These workshops were held in Jamaica, Malta and Sri Lanka.

Training for the future

In 1996, UNU held a Multilateral Diplomacy workshop in Tokyo to provide training for 15 young Asian diplomats on how to incorporate scientific knowledge into multilateral environmental negotiation. Many diplomats do not seem to be aware of or lack experience

dealing with such information. As a result, they are often challenged when confronted with complex multilateral problems such as the environment and development because these problems require knowledge and solutions beyond their traditional training. In the past, diplomatic negotiations tended to focus on political goals, neglecting often unwanted scientific input. This caused many global environmental treaties to be ineffective, often reflecting political horse-trading rather than a dispassionate appraisal of what would actually work. For example, there is little likelihood that an international treaty for reversing ecological damage will work if it was negotiated with only domestic political advantage in mind. This is why UNU brought diplomats and scientists together: to help diplomats understand the environmental implications of what they are negotiating.

For seven days diplomats attended workshops and seminars given by prominent scholars on topics such as interpreting integrated models and understanding the legal implications of environmental treaties. UNU also led a two-day environmental simulation exercise after the workshops to show how sustainable growth can be achieved. The exercise demonstrated real-life problems which diplomats encounter. And many of the diplomats were surprised when shown how global environmental problems impact on their own countries.

UNU held a similar workshop again in 1997. And UNU organized another environmental training course in Bangkok, Thailand. This course was titled the "AIT Training Course on Planning for Environmentally Sustainable Development in the Asia Pacific Region." It was held in 1996 at the Asian Institute of Technology.

This work also responds to Agenda 21's chapter 8: *Integrating Environment and Development into Decision-making*.

Climate change

UNU and the Intergovernmental Panel on Climate Change (IPCC) have been working together on the issue of global warming. Their work has focused on Integrated Assessment Models (IAMs). IAMs are computer simulation models that evaluate the effects of human activities on the environment. Their results can be used to communicate clearly information between scientists and policy makers. However, the models have failings. One is that they still look at the world in a very course-grained way, unable to resolve details that, while small, matter a lot. Another is that scientists are concerned that they are not yet very applicable to developing countries. To help resolve these problems, the UNU held two meetings in Tokyo to improve the quality of IAMs and to integrate developing-country perspectives into them.

The first meeting was the "IPCC Asia-Pacific Workshop on Integrated Assessment Models." This meeting had three main outcomes. First, 140 prominent scholars from around the world exchanged their recent IAM research results on climate change. Second, developing countries were informed about the latest scientific and technical information on these issues. And third, it gave policy makers an in-depth analysis of climate change concerns as they prepare for December's Third Conference of the Parties under the Climate Change Convention (COP3) in Kyoto, Japan.

The second meeting was the "Tokyo Modelling Forum on Integrated Global Environmental Assessment." This meeting also had three main outcomes: researchers were able to compare how different IAMs stabilize C02 emissions and affect climate change, they made some progress in expanding the use of IAMs to developing countries, and were able to extend IAMs' climate change framework to include more sustainable development-related issues. Both meetings were held in the spring of 1997.

UNU researchers are working with other partners on the issue of climate change. In 1996, they began a joint project with India's Tata Energy Research Institute (TERI) that helps decision makers understand what is happening in the ongoing Framework Convention on Climate Change (FCCC) implementation process. Their work has focused on the following objectives:

- studying what has been done so far in implementing the FCCC;
- organizing workshops and meetings to determine the best way of influencing future climate change negotiations;
- creating a "blueprint for action" that will be presented at COP3; and
- publishing a document that captures how the FCCC is being implemented and what could be done to improve the process. The first draft of this document has already been completed, and will be finalized for presentation at COP3 in Kyoto in December 1997.

This work responds to Agenda 21's chapter 9: *Protection of the Atmosphere*.

Creating partnerships for sustainable development

The UNU and Japan's Environment Agency (EAJ) founded the Global Environment Information Centre (GEIC) in response to Agenda 21. GEIC is a centre for global projects, networking and information on environmental issues. Its work promotes new levels of cooperation and understanding among nations, key sectors and people to achieve environmentally sustainable development. The programme has three parts. The first programme part is global projects. The GEIC's global projects fulfil a unique role: creating mechanisms to link NGOs with international policy-making processes. Its first project, titled "Global Governance and the Role of NGOs," searches for ways the UN system and international policy processes can better achieve Agenda 21's chapter 27 objectives. During GEIC's first year, the focus is climate change, linking the Centre to the 1997 Conference of the UN Convention on Climate Change in Japan. Prior to the conference, the Centre will present its findings on a Climate Change Secretariat-commissioned study on NGO Consultative Mechanisms in Bonn, Germany.

And GEIC is also working with UNITAR and the Climate Change Secretariat to put CC: TRAIN, a six module climate change training workshop, into CD-ROM format.

The second programme part is networking. The GEIC implements several sustainable development networking and information exchange activities, including homepage and database development. And it offers free server space and support for NGO groups worldwide.

The third programme part is public information. The GEIC introduces the public to environmental issues through exhibitions, educational events, audiovisual presentations, news

bulletins and networking information. Their first exhibition had the theme "Networking for the Future."

Monitoring pollution in East Asia

UNU has a project that is monitoring water, soil, food, air, sediment and fish across East Asia. The project's objectives are to standardize and calibrate analytical methodologies in the East Asian region, as well to provide high-level training to scientists. Researchers have so far analysed pesticides in rice and PCBs in the region's soils. Laboratories in more than 10 countries are participating: China, Hong Kong, Indonesia, Japan, Republic of Korea, Malaysia, Philippines, Singapore, Thailand and Viet Nam.

Training and capacity-building are the major focuses of the project. This includes: training in sample collection, sample preparation and video analysis; providing standard manuals and training videos; on-the-spot training; and analytical equipment training as necessary. Information systems have also been established to promote information exchange and access, such as connections to e-mail and the Internet.

Under the project, UNU is developing a regional environmental database called LANDBASE. This database focuses on information pertaining to land-based sources of pollution in East Asia. The University's ultimate objective is to monitor compliance with international environmental accords, and to strengthen national environmental obligations. The project is supported by UNEP and has been identified as one of the projects which work to implement the East Asian Seas Action Plan. The project also relates to the implementation and compliance of other environmental accords: the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, the Biodiversity Convention, the Basel Convention on the Transboundary Movement of Hazardous Wastes, and the Ramsar Convention on Wetlands.

UNU is also studying water pollution in Asia. The University has been designated as the implementing centre for the UNU/IOC-UNESCO/UNEP Asia-Pacific Mussel Watch. Researchers, under the direction of Shinsuke Tanabe, are working together to measure the extent of pollution in Asia's marine coastal areas. To do this, they are monitoring mussels. Mussels are a good species for learning about pollution because contaminants accumulate in their bio-valves as water is filtered through. And because mussels live near the shore, researchers are able to get a good idea from them about the extent of pollution running off the land. The project has been able to develop an extensive database from its findings.

Water and peace

UNU researchers are working on responses to Agenda 21's Chapter 18: *Protection of the Quality and Supply of Freshwater Resources*. Water is a very important resource for socio-economic development. And it is a particularly crucial resource to the countries of the Middle East. In recent years, water consumption in these countries has exceeded annual supply, the difference being made up by overdrawing from fragile groundwater systems. Larger shortages are expected in the future.

To help find solutions to this problem, UNU and the International Water Resources Association (IWRA) convened the "Middle East Water Forum" in Cairo, Egypt, in 1993. Twenty-seven of the world's leading water experts were invited to discuss problems of sharing the limited water-resources available in an arid region. The results of this Forum were compiled into *International Waters of the Middle East: From Euphrates-Tigris to Nile*. The book was edited by Asit Biswas and provides the following:

- a description of the region's water problems;
- a historical background;
- suggestions for technical collaboration in the Euphrates-Tigris basin;
- ideas on what could be done to distribute the Nile's water more equitably; and
- a comprehensive analysis of international water management.

The participants stressed that the countries concerned must work together on water management programmes if lasting peace and prosperity in the region is to be achieved. Unilateral actions will not work.

As a follow-up to this forum, two books were produced that provide innovative technological answers to the fundamental questions of how to sustain the Middle East's present and future water supply: *Managing Water for Peace in the Middle East: Alternative Strategies* and *Hydropolitics along the Jordan River: Scarce Water and its Impact on the Arab-Israeli Conflict*.

In *Managing Water for Peace in the Middle East: Alternative Strategies*, the author, Masahiro Murakami, evaluates new non-conventional approaches to water-resources, ones which need to be considered if peace is to be established. First, he reviews arid zone hydrology, emphasizing the constraints to water-resource development and management in the world's arid zones. Second, he discusses the desalination of ground and sea water as possible sustainable water-resource development plans for regions in the Middle East where peace is at risk. Third, he considers the application of hydroelectric-powered reverse osmosis desalination as an option for Kuwait. Fourth, he applies non-conventional water-resource development ideas to Jordan's national water plan for consideration. Jordan's renewable water-resource development potential is limited and will most likely be exhausted within a few years. (There are, however, various development alternatives involving conventional waters, such as surface and groundwater, and non-conventional waters, including brackish, sea, and urban waste water.) And fifth, he discusses integrated water-resource development and management for the Jordan River system. Technological and political alternatives are provided, outlining possible resource sharing and joint development opportunities for Israel, Jordan and Palestine.

Aaron Wolf's *Hydropolitics along the Jordan River: Scarce Water and its Impact on the Arab-Israeli Conflict* has two interconnected goals: developing an interdisciplinary framework for water conflict analysis and applying it to the Jordan River watershed dispute. Mr. Wolfs book is particularly informative in four ways.

First, he provides a detailed description of the Jordan River watershed and how human interaction has altered its hydrography. Second, he gives a comprehensive history of water

conflict and cooperation in the watershed, beginning with the origins of agriculture through to the hydropolitical intricacies of the twentieth century. Third, he explores the possibility of using the social sciences – law, political science, economics, game theory and alternative dispute settlement – to the process of conflict resolution. Fourth, he proposes an integrated model for water basin analysis and conflict resolution, and a four-staged process for regional development:

- negotiate an equitable division of existing resources;
- emphasize greater efficiency for water supply and demand;
- alleviate short-term needs through inter-basin water transfers; and,
- develop a regional desalination project in cooperation-inducing stages.

He stresses that both the hydroscientific and hydropolitical aspects of watershed development must be addressed if water is to be used successfully as a catalyst for peace. And he warns that the more complex a watershed proposal is technically, the more complex it will be politically.

He also gives four less complicated recommendations for solving water scarcity problems: reclaiming water in urban centres for use in agriculture and for personal consumption; investing in water-efficient agriculture, such as drip irrigation; overhaul current water-delivery systems to stop leakage and excessive evaporation; and allow the price of water to rise to its real market value.

The 1995 "UNU Central Eurasian Water Forum" expanded on the work carried out in the Jordan River basin to include the two major Central Eurasian water bodies: the Aral and the Caspian Seas. Both of these inland seas are experiencing severe environmental disturbances because of human development activities.

In the same year, the Committee on International Waters of IWRA, together with UNU and UNEP, held a meeting of experts on Asian water-resources in order to address the complex issues of three watersheds: the Mekong, the Granges-Brahmaputra and the Salween. Twenty-seven experts from the region and representatives from international organizations attended the event, which was hosted by the Asian Institute of Technology in Bangkok, Thailand.

Participants were asked to consider implementing three points. The first is to involve all stakeholders in all planning processes. The second is to ensure that everyone, especially politicians, are aware of the consequences of not cooperating. And the third is to realize that lasting agreements cannot be externally imposed, but must come from those involved.

The high seas

UNU's researchers have worked on responses to Agenda 21's chapter 17: *Protection of the Oceans*. They are focusing their efforts at policy level. UNU and the International Ocean Institute (IOI) have worked together on several Pacem in Maribus (PIM) Conferences, searching for feasible ways of promoting sustainable development in the planet's oceans. UNU published a book entitled *Ocean Governance: Sustainable Development of the Seas*. The volume, edited by Peter Bautista Payoyo, is a collection of papers presented at the PIM's 19th Conference held in Lisbon, Portugal.

The papers contained in the book examine the institutional implications of sustainable ocean development. National, regional and global dimensions of ocean governance are explored, urging on policy makers the importance of integrating oceans into environmental protection strategies.

UNU researchers, working on another maritime-related study in Sassari, Italy, organized a series of workshops and projects on Integrated Management of Protected Coastal Areas. And they helped establish the Database on Education and Training on Integrated Coastal and Ocean Management. This database will contribute substantially to coastal management capacity building.

Who should clean up?

Effective policies to prevent global warming and climate change are needed urgently. But international negotiations on the issue repeatedly come up against the problem of how to allocate responsibility for the greenhouse effect, and who should bear the cost of remedying the problem. UNU researchers have found a unique, interdisciplinary and multinational response to the challenge. The results of their international collaborative study are contained in the volume *The Global Greenhouse Regime: Who Pays?*

The book, edited by Peter Hays and Kirk Smith, accomplishes three things. First, it outlines advanced greenhouse indices. Second, it clarifies technical greenhouse gas emission issues. And third, it discusses the economic responsibilities countries have based on their emissions. It concludes with a discussion of the *realpolitik* of climate change negotiations – what really is at stake and for whom.

A central issue in greenhouse negotiations is the allocation of costs. One of the book's unique contributions is the researchers' proposed composite index which determines who should pay for creating a global greenhouse gas regime. The index incorporates both the ability to pay and the polluter pays principles.

This work responds to the Framework Convention on Climate Change.

Working towards sustainability

Researchers at one of UNU's five research and training centres5 have initiated a project that will describe their centre's work on sustainable development. They will accomplish this in two ways. First, they have set up a homepage located at http://archive.unu.edu/ias/sus. And second, they plan to hold an electronic forum in the LISTSERV list "IAS-CR6." Such topics as the progress toward sustainable development made since Rio and how to effectively implement Agenda 21 will be discussed.

Foot Notes

1. According to UNUs *Mega-city Growth and the Future*, by the year 2000 there will be six mega-cities with populations exceeding eight million in developed countries and 22 in developing countries. Developed countries: Los Angeles, Moscow, New York, Osaka, Paris, Tokyo. Developing countries: Bangalore, Bangkok, Beijing, Bombay, Buenos Aires, Cairo, Calcutta, Dhaka, Delhi, Istanbul, Jakarta, Karachi, Lagos, Lima, Manila, Mexico City, Rio de Janeiro, So Paulo, Seoul, Shanghai, Teheran and Tianjin.

2 For a more complete analysis, see *UNU/WIDERs Study Group Series No. 7, The Environment and Emerging Development Issues*, 1992.

3 The five environmental agreements were: the World Heritage Convention, the Convention on International Trade in Endangered Species, the International Tropical Timber Agreement, the London Convention on the Dumping of Pollutants in the Ocean, and the Montreal Protocol on Substances that Deplete the Ozone Layer.

4 The companies interviewed were: Organon Mexicana, Ciba Geigy Mexicana, Bayer de Mexico, BASF Mexicana, Celanese Mexicana, Cementos Apasco, Kodak Mexicana and Curtidos Temola.

5 In addition to its Headquarters, UNU has five research and training centres: the World Institute for Development Economics (UNU/WIDER) in Finland; the Institute for New Technologies (UNU/INTECH) in the Netherlands; the International Institute for Software Technology (UNU/IIST) in Macau; the Institute for Natural Resources in Africa (UNU/INRA) in Ghana; and the Institute of Advanced Studies (UNU/IAS) in Japan. The University also has three research and training programmes: the International Network on Water, Environment and Health (UNU/INWEH) in Canada; the International Leadership Academy (UNU/ILA) in Jordan; and the Programme for Biotechnology in Latin America and the Caribbean (UNU/BIOLAC) in Venezuela.

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