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*A Review of Research Activities of  
The United Nations University*

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## Introducing the UNU Environment and Sustainable Development Programme

Governed by the overall mission of the United Nations University, the Environment and Sustainable Development (ESD) Programme at the UNU Centre focuses on the interactions between human activities and the natural environment, and their implications for the sustainable management of natural resources. The basic issues of human survival, development and welfare are at the core of the themes covered within the realm of the ESD Programme. Environmental governance and the monitoring tools required for designing and implementing effective environmental policies are also fundamental ESD Programme concerns.

To achieve its objectives, the ESD Programme adopts a multidisciplinary approach combining both natural and social sciences. In implementing activities, special efforts are made to include perspectives from both North and South as well as from the countries with economies in transition. Capacity building, particularly in the developing countries, is given high priority.

Four broad themes are identified for the ESD Programme: natural resource management, water crises, global environmental governance, and sustainable urban and industrial development. The ESD Programme operates through an international network of scholars and institutions bridging across both industrialized and developing countries. The establishment of strategic partnerships is a key principle used to promote multidisciplinary research and policy analysis at an international level.

The ESD Programme activities are focused on groups and institutions such as the UN system, international academic community, international policy community and others. In a concrete effort to reach some of the appropriate target groups, the ESD Programme established the Global Environment Information Centre (GEIC), in collaboration with the Environment Agency of Japan. GEIC is committed to achieving better involvement of civil groups and the general public in environmental issues, and undertakes studies and activities that can engage grassroots organizations in international and national environmental processes.

This issue of *Work in Progress* focuses on some of the recent initiatives and successes of the UNU ESD Programme. The twelve articles provide details on a variety of research projects and issues, ranging from the sustainable development and use of natural resources to effective means of coping with the pollution and climatic change. 

– *Motoyuki Suzuki, Vice-Rector  
Environment and Sustainable Development*

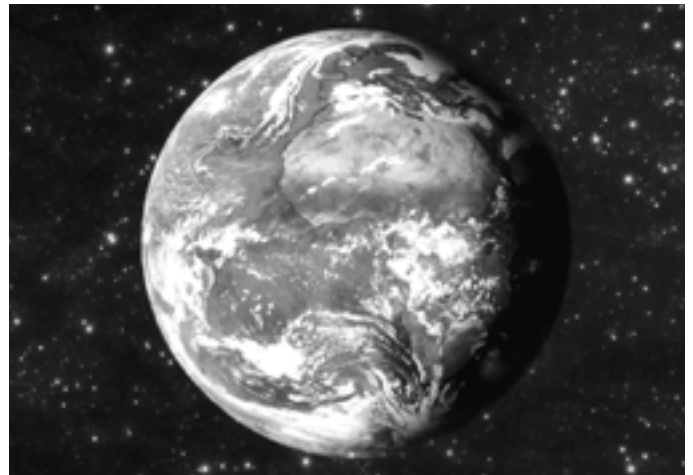


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# Biodiversity Conservation through Agrodiversity: PLEC Mid-Term Report

By Luohui Liang, Michael Stocking, Harold Brookfield, Christine Padoch and Libor Jansky

## Background

*People, Land Management and Environmental Change (PLEC)* is a long-standing flagship project of the United Nations University (UNU). The project was established in 1992 – the year of the *Earth Summit* in Rio de Janeiro – as an initiative to examine the relationships between population and environmental change in rural areas of developing countries. The original focus was on research, with the objective of providing practical options for better management. PLEC eventually evolved, however, into the novel theme of “agrodiversity,” which was defined in 1994 as “the many ways in which farmers use the natural diversity of the environment for production, including not only their choice of crops but also their management of land, water, and biota as a whole.”<sup>1</sup> Agrodiversity has since become a central concept to PLEC, leading its members to examine closely how farmers manage all their resources, especially (but not only) biotic resources.

In 1998, PLEC joined the Global Environment Facility (GEF) work programme, with UNU as the executing agency and the United Nations Environment Programme (UNEP) as the implementing agency. The evolution in focus has turned PLEC from primarily a research project into a large demonstration and capacity-building project – one whose main activities involve the participation of small farmers in the conservation and sustainable use of their natural resources (especially, biodiversity). PLEC seeks to document the value of “agrodiversity” as a basis for viable approaches to conserving and even enhancing biological diversity. Land quality is also monitored by noting how local people adapt to changes in natural and social conditions.

The role of agrodiversity in conserving biodiversity is demonstrated through the diversity of resource management and cropping systems, especially indigenous knowledge of the management of fragile and variable environments, local genotypes of food crops, intercropping and agroforestry systems. Evidence is accumulating that not only is there a wealth of good practice in many previously-overlooked local techniques for biodiversity conservation, but also techniques that reduce the risks of land degradation, support resource-poor farmers’ livelihoods, and give tangible evidence of sustainability. PLEC dwells on positive experiences to draw lessons in support of agrodiversity as a developmental approach with policy-relevance to reversing trends in the accelerated loss of biodiversity and increasing degradation of land.

The emerging mainstream on agrobiodiversity conservation emphasizes the conservation of genetic materials. The success of conservation efforts, however, lies in maintaining the processes that create and preserve genetic diversity, and in this agrodiversity – which stresses management, and distinguishing good from indifferent management at household level – is central. Value judgements on management quality are based on both the conservation of

biodiversity and the support given to rural livelihoods. PLEC is concerned not with statistical means across populations, but with differences between the practices of individual farming households. By analyzing differences in management, PLEC seeks to develop a methodology for taking this important element into account for biodiversity conservation.

While the PLEC theme centres on agrodiversity, the approach spontaneously began to change to participatory research with farmers in 1996. The FAO Leipzig conference on conservation of crop-plant genetic resources and the third meeting of the Conference of Parties to the Convention on Biological Diversity gave clear priority to participatory work by scientists with small farmers, and stressed the importance of small farmers as custodians of biodiversity. When GEF decided to support PLEC, the old term “focus areas” was replaced with “demonstration sites.”

PLEC demonstration sites were recently described as:

places or areas in which PLEC scientists, farmers and other environmental stakeholders carry out work in a participatory manner to conserve and even enhance agricultural and biological diversity and the biophysical resources underpinning it. [They are] areas where the scientists work with farmers in the creation of projects that are the farmers’ own, and where, together, the scientists and farmers demonstrate the value of locally-developed techniques and technologies.... The role of the scientist is to facilitate, measure and evaluate local methods, and help to select the method most likely to be sustained”<sup>2</sup>

In other words, the scientists act more as facilitators than as interventionists. They learn from the farmers, and assist successful farmers to train others.

PLEC operates through an international network of locally based clusters (groups) that are now established in West Africa (Ghana and Guinea), East Africa (Kenya, Tanzania and Uganda), Asia-Pacific (China, Thailand and Papua New Guinea) and America (Brazil, Peru, Mexico and Jamaica). These clusters are multidisciplinary organizations that collaborate with other relevant institutions, including research institutes, universities, government agencies, NGOs and co-operating farmers. They work through more than 20 demonstration sites, representing a diversity of priority ecosystems at the margins of forests, semi-arid regions, mountains and wetlands.

The overarching goal of the project under GEF support from 1998 to 2001 is to develop sustainable and participatory approaches to conservation (especially of biodiversity) within small farmers’ agricultural systems. Participation is a strong and pervasive theme of all PLEC work. Specific objectives are to:

- establish historical and baseline comparative information on agrodiversity and biodiversity at the landscape level in representative diverse regions;

<sup>1</sup> Brookfield, H. and C. Padoch, “Appreciating Agrodiversity: A Look at the Dynamism and Diversity of Indigenous Farming Practices,” *Environment* (36 (5):6-11, 1994; pp. 37-43). “Agrodiversity” places emphasis on management and the organization of production, including management of agro-biodiversity.

<sup>2</sup> Abdulai, A.S., E.A. Gyasi and S.K. Kufogbe, “Mapping of Settlements in an Evolving PLEC Demonstration Site in Northern Ghana: An Example in Collaborative and Participatory Work,” *PLEC News and Views* (14, 1999; pp. 19–24).



PLEC expert farmer, Ms. Maria Rosario (centre), explaining how she manages her home garden near the mouth of the Amazon (Photo: Libor Jansky, UNU)

- develop participatory and sustainable models of biodiversity management based on farmers' technologies and knowledge within agricultural systems at the community and landscape levels;
- recommend approaches and policies for sustainable agrodiversity management to key government decision makers, farmers and field practitioners; and,
- establish national and regional networks for capacity strengthening within participating institutions.

### Progress achieved and lessons learned to date

PLEC is now more than halfway through the present four-year phase under GEF support, which started in March 1998. Significant progress has been made on the work plan towards project goals and objectives, especially in terms of site establishment and baseline inventory, development and demonstration of best models, and capacity building and networking. The following is a summary of mid-term progress.

#### Demonstration sites

Setting up viable demonstration sites was one of the priority tasks in the beginning of the GEF phase. These sites are not so much physical plots as people-centred processes: coalitions and partnerships among scientists, local communities and other stakeholders searching for sustainability. Some of the sites were those in which project members had previously worked or were still working in connection with other projects, while others were new. It was not as simple a task as had been anticipated, however, especially for those clusters that were not familiar with the PLEC approach.

Some clusters had, before early 1999, carried out activities within large transects that covered several agro-ecological zones. Some were overwhelmed by their own research agendas, or were unable to create a genuine coalition with farmers and other local stakeholders. Later clusters were thus advised to concentrate their work in more narrowly defined areas, and to benefit from the experiences of other successful clusters.

As a result, it took some time for all clusters to move from the stereotypical agricultural or agrarian research approach to the concept of partnership with real farmers and local communities. Following

this advice, PLEC-Tanzania, for example, quickly resolved to narrow its key demonstration sites to two landscape units (selected from five units they had identified) on the windward and leeward slopes of Mount Meru in Arumeru District. Since then, the cluster has made rapid progress in all respects at these two main sites.

Other factors, such as security issues, also created difficulties for choosing viable sites. In Papua New Guinea, for example, a proposed demonstration site in the Tari basin, Southern Highlands Province, had to be dropped due to regional tribal conflicts.

So far, a total of 21 demonstration sites in eight GEF-supported countries (Brazil, China, Ghana, Guinea, Kenya, Papua New Guinea, Tanzania and Uganda) and 6 sites in four UNU-supported countries (Jamaica, Mexico, Peru and Thailand) have been established and are now operational. Further demonstration sites are in development, some in response to popular demand from nearby communities. Due to limited resources and time, however, initiating new sites has not been encouraged in the current GEF phase. Rather, high priority is given to achieving all objectives at existing sites on schedule.

#### Agrodiversity and biodiversity assessment

PLEC thrives through the diversity of ways that it looks at "agrodiversity" in different regions. Under the GEF phase, however, minimum requirements for the agrodiversity and biodiversity inventory had to be set for effective monitoring, and less advanced clusters need a practical and scientific methodology that conforms to international standards. For integration and comparison of baseline data, a diversity of previous inventory methods was harmonized. In 1998, the first year of the GEF phase, Scientific Coordinators prepared provisional guidelines on agrodiversity assessment in demonstration site areas by first categorizing "agrodiversity" into four elements, i.e., biophysical diversity, agrobiodiversity, management diversity and organizational diversity.

For collection and analysis of agrobiodiversity data, a Biodiversity Advisory Group (BAG) drawn from the Amazonian, China and West Africa Clusters was established to harmonize existing methods and develop a common methodology. In early 1999, the methodology paper was completed.<sup>3</sup> The basic principle was to stratify the landscape at demonstration sites by land-use stage and field type for a biodiversity sampling survey. Subsequently, guidelines on agrodiversity assessment in demonstration site areas were revised as a companion to the BAG guidelines.<sup>4</sup> In order to conduct detailed investigation, the sampling frame for agrobiodiversity and agrodiversity assessment is now based on land-use stages and field types. (The reconnaissance survey during the pre-GEF phase period was largely an assessment along transects.)

Most of the necessary data has been assembled, although data quality varies across clusters. Compiling the data into database form at national level is under way, with technical advice from a database expert in PLEC. A database structure in MS Access format, an

3 Zarin, D. J., H. Guo and L. Enu-Kwesi, "Methods for the Assessment of Plant Species Diversity in Complex Agricultural Landscapes: Guidelines for Data Collection and Analysis from PLEC-BAG," *PLEC News and Views* (13: 3-16, 1999; Special Issue on Methodology).

4 Brookfield, H., M. Stocking and M. Brookfield, "Guidelines on Agrodiversity Assessment in Demonstration Site Areas," *PLEC News and Views* (13: 17-31, 1999).

operational manual and a sample database were produced for reference.<sup>5</sup> Training has been provided to clusters in China, Thailand and West Africa. Based on legal and logistical considerations, the raw data is held by clusters in their own countries; only aggregated results will be reported and compiled into a database in UNU.

The detailed participatory assessment not only provides baseline data – it also identifies and documents good practices in agrodiversity. Expert farmers for the second objective (developing participatory models of biodiversity conservation) have also been located.

Preliminary findings have shown that agriculture, or other forms of management of natural resources, does not necessarily reduce biodiversity. On the contrary, it may enhance biodiversity and improve land quality. On the other hand, biodiversity supports local livelihoods. Many traditional and modern methods of soil fertility and moisture management and soil erosion control, for example, have been identified in the PLEC demonstration site in Tanzania. And analysis of the accumulated data gathered over many years by the Amazonia Cluster shows how small farmers have preserved and even enhanced biodiversity in the Amazon floodplains.

As part of a strategy to increase the number of outputs, farmers are protecting the seedlings of timber species to enrich their future fallows. Farmers report also that the majority of timber, fruit and other valuable species do not regenerate under the canopy. As a result, gaps of different sizes need to be made and maintained to keep a fallow rich in valuable species. It also has been found, at islands near Santarém, Brazil, that a moderate intensity of buffalo/cattle activities on floodplain forest may enhance diversity. Biodiversity assessment at the Kiambu site (Kenya) shows higher species richness in cultivated private lands than in natural forest.

Land tenure change has also been reported to have an important influence on agrobiodiversity conservation. The household-level study by the China Cluster is helping to measure and analyse the fascinating process of household diversification after the breaking up of communes into individual holdings under the “household contract responsibility system” in the early 1980s.

A study on effects of the high flood of the Amazon in 1999 during a La Niña event on natural and social landscape of the PLEC demonstration site in Peru (Sector Muyuy, Iquitos) showed that, despite the exposure of their houses and house gardens to floods, the majority of farmers in the selected villages did not perceive the high flood as a catastrophic event. The farmers have developed various coping strategies and techniques to minimize the flood damage, while flooding brings benefits such as an abundance of fish, a decline in the population of field mice and other pests, and deposition of new fertile sediments in their fields.

### Best models development

For developing best models for biodiversity conservation, a distinguishing feature of the PLEC approach is to work with skilled (“expert”) farmers in devising and propagating patterns that combine superior (or more secure) production with preservation or enhancement of biological diversity in their fields. Scientists seek out the most efficient farmers to learn how they manage or conserve their biodiversity and other resources better than others.

5 See <http://www.unu.edu/env/plec/database.html>.

To assist other clusters, a guideline paper was prepared based on Amazonian Cluster’s successful experience in demonstrating good practices in agrodiversity with expert farmers. General adoption of this distinctive approach throughout the PLEC network was greatly facilitated by the formation of the Demonstration Activities Advisory Team (DAT), which has conducted field training and shared experiences with clusters in China, Ghana, Kenya, Papua New Guinea, Tanzania, Thailand and Uganda.

All clusters have now adjusted their demonstration approach from scientist-directed intervention to farmer-led capacity building. Identification and documentation of good practices and expert farmers continues vigorously for demonstration purposes. The PLEC approach has yielded encouraging results at demonstration sites. PLEC-Tanzania, for example, has reported farmer-engineered training sessions to be more relevant and more acceptable to fellow village farmers than those conducted by experts. Participating farmers have adopted, and are currently practicing, those methods they find both useful and relevant, and farmers and communities outside the current PLEC sites are volunteering to participate in PLEC activities.

Another important aspect of PLEC development of best models is to assist in the formation of farmers’ associations and to work with existing farmers’ unions. In Ghana, PLEC farmers’ associations have conducted various conservation activities, including:

- conservation of trees on farms, in relict forest groves and in other mini bio-reserves;
- nurseries of rare and preferred plant species;
- conservation of indigenous varieties of rice;
- soil conservation through stone terracing/lining and grass bunding along slopes, and agronomic and vegetative measures; and
- tree planting.

On 5 November 1999, the PLEC farmers’ association of southern Ghana hosted a major show of traditional meals based on endangered biotic species at the Sekesua-Osonson demonstration site to highlight the value of agrodiversity. Over 1,000 people attended, including farmers, government officials, PLEC scientists and representatives from Papua New Guinea Cluster and Coordination. The show received national TV coverage and was featured in a popular national daily newspaper.

In Guinea, PLEC women dyers in villages at Pita demonstration sites have formed a special group as a local enterprise for the sustainable use of local plants in making traditional costumes (for home consumption and the market). They have set up a shop in Conakry for improving market access. Also at Pita, a group of gardeners has revitalized a traditional method of making compost to improve food production in fenced fields. Their efforts have been recognized by support from the World Food Program.

### Capacity building

The PLEC global network serves well the special UNU mandate to alleviate intellectual isolation of academics and contribute to capacity building in developing countries. BAG integrates expertise from three clusters (Amazonia, China and West Africa) to develop guidelines on biodiversity assessment for the whole network, while DAT brings experiences and expertise gained in some clusters to help other

clusters and to develop strategies for carrying out demonstration activities. Regional cooperation is conducted through multi-country clusters in West Africa, East Africa and the Amazonian basin. A comparative study on floral and management diversity in the dry zone of Ghana and Guinea is being undertaken between two sub-clusters of West Africa. So far, four project General Meetings have been organized to foster international exchange across all clusters; the most recent was held in Macapa, Brazil (26–30 May 2000).

At same time, PLEC promotes networking at national level. PLEC-Ghana now has three teams based in southern, central and northern Ghana. PLEC-Tanzania has involved participants from the Ministry of Agriculture. And two NGOs (Asociación Mexicana para la Transformación Rural y Urbana – AMEXTRA and Grupo Interdisciplinario de Tecnología Rural Apropiada-GIRA) are now partners of PLEC-Mexico. Working with PLEC, individual scientists are re-trained in a farmer-centred approach as well as in computer, language and other research skills. More than 40 graduates and junior researchers have received “on the job” training in the PLEC approach to rural development with conservation, and some of them are doing their theses based on PLEC work.

The scope of PLEC capacity building goes beyond academic training; demonstration of best practice also involves farmer-to-farmer training. The rate of adoption of new or better management technologies has proven to be greater with farmer-engineered training sessions than any other approaches previously employed. From July 1999 to June 2000, PLEC-Peru conducted 44 demonstrations in Sector Muyuy, Iquitos, organized as community or family working days for expert farmers to share their successful practices with their fellow farmers; each demonstration was attended by an average of 26 farmers. In addition, farmers in the villages have received training on needed practical techniques on new farm inputs, crops and animals. Exposure to what PLEC does with farmers also sensitizes agricultural

extension workers and other official associates to the knowledge and skills of the best farmers.

University and school courses and even village-level literacy classes are promoted. A collaborative postgraduate training programme between China Cluster and a local university, for example, involves 1 or 2 postgraduates in PLEC work each year. PLEC concepts and approaches are also incorporated into an undergraduate degree programme at Makerere University, Uganda. PLEC environmental education courses for school teachers and community leaders are proving to be an effective way to generate discussion within and between communities on local environmental issues, and are serving as a starting point for developing community projects to address local agricultural and resource management issues near Santarém, Brazil. Family schools in Macapa, Brazil, are teaching young people local knowledge and skills for a productive rural livelihood, which they do not learn from the regular schools.

The PLEC network has expanded to include more than 200 professionals, including core and associated scientists, young researchers and students (the majority of whom are in developing countries) plus several hundred participating farmers. There are now more than 40 institutions (research, university, government, or NGO) in the PLEC network. The PLEC network uniquely provides both for South-to-South co-operation and South-to-North twinning arrangements.

### Policy recommendations and dissemination

Policy recommendations and dissemination are being promoted through publications, conferences, PLEC stakeholder workshops and involvement of officials in PLEC work. The project periodical, *PLEC News and Views* (16 issues to date), offers a quick channel to inform PLEC results to project members as well as general public, and the PLEC homepage<sup>6</sup> is an effective platform for dissemination.

Under separate UNEP support, a PLEC Scientific Coordinator has led an initiative for production of *Land Degradation – Guidelines for Field Assessment* to provide assistance on collecting measurements and assessments of land degradation. The working paper (available on the PLEC homepage) will have wide application beyond PLEC.

PLEC representatives have made presentations at COP4 and COP5/CBD, and COP2 and COP3/CCD, and other important international conferences. One such important presentation was the PLEC-Tanzania report, “Agrodiversity as a Means of Sustaining Small-Scale Dryland Farming Systems in Tanzania,” at the 15th Session of the Global Biodiversity Forum. It made a substantial contribution to the contents of the thematic report on “Agricultural Biodiversity and Sustainable Livelihoods: the Case of Dryland Ecosystems” to the COP5/CBD agenda. It was well noted that PLEC did not focus only on agricultural biodiversity *per se* but also the management and organizational diversity that bring about agrobiodiversity conservation under small-scale farming systems, especially in drylands.

A PLEC Advisory Group has been set up to keep PLEC in contact with other relevant initiatives in the CGIAR and UN systems, as well as for liaison with bilateral donors and NGOs. PLEC stakeholder workshops are organized annually by clusters in-country, often

One of the important points in the process of understanding the uses of fallows at sites near Macapa, Brazil is to grasp the way people define management. For the majority of farmers management is a technical activity practiced by professionals. As a result, when farmers are asked if they manage their fallows or forests, their answer is usually that they do not because technicians from state and private institutions did not teach them how to do it. However, if you ask them why their fallows contain a high density of individuals of valuable species, their answer is because they take care (*tomar conta*) of the vegetation the way they know how (*do jeito que a gente sabe*). Complex and diverse management systems, methods and techniques were recorded by asking the members of the 25 sampled families how do they *tomar conta* (manage) their fallows. It is found out that smallholders are managing their fallows using three main management systems, four main methods, and five main techniques, and they conduct an average of six main activities

Excerpt from David G. McGrath, “Progress Report to United Nations University/PLEC-Amazonia Cluster, March 1998–February 1999” (Belem, Brazil; ms., 1999).

6 <http://www.unu.edu/env/plec/>

# A Retrospective Study of the 1997–98 El Niño: Identifying Major Challenges and Opportunities

By Zafar Adeel and Michael Glantz

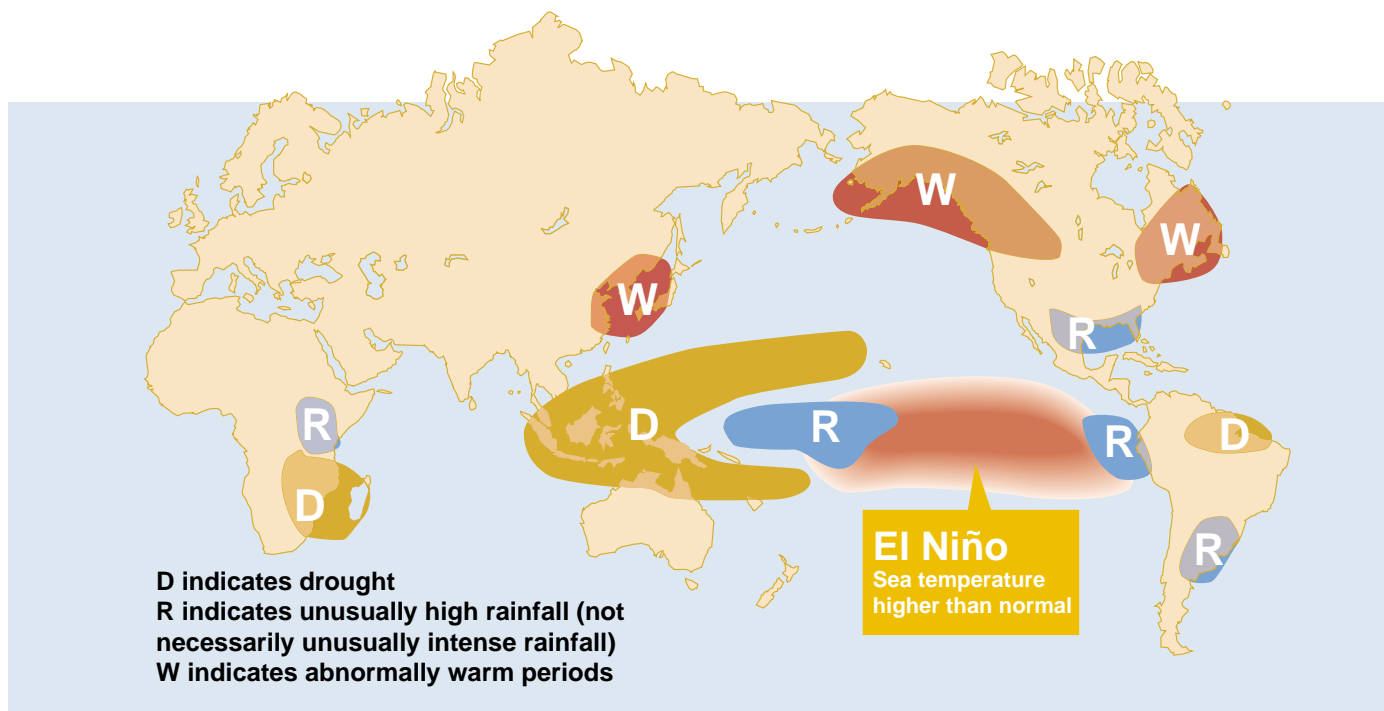
El Niño has become a household word in many parts of the world since 1997. The 1997–98 event was the first time that highly-visible forecasts of El Niño’s impacts were made, and major media groups focused their attention on these impacts. This greater visibility, combined with the unusual strength of that El Niño phenomenon, earned it the dubious title “El Niño of the Century.”

In its aftermath, a number of research groups, government agencies, international organizations and societies at large began looking for answers to some key questions: How can we tell when an El Niño is coming, and how strong it will be? Where will the worst

damage occur? How can we prepare ourselves for its impacts? What can be done differently to mitigate future problems?

The answers to these seemingly straightforward questions are often complex and convoluted. The complexity is partly driven by uncertainties at various levels: scientific, social, political and economic. The study described in this paper is an attempt to provide guidelines to finding answers to these key questions.

**The 1997–98 El Niño and its major impacts**  
Let’s first look briefly at what happened during the 1997–98 event.



Climatic impact of El Niño event (October 1997–March 1998)  
Source: Food and Agriculture Organization of the United Nations (FAO)

## Biodiversity Conservation through Agrodiversity *(Continued from page 5)*

including field visits to demonstration sites. Officials, especially from local government, have participated in PLEC activities. Local management bureaus for nature reserves in China, for example, incorporated some of PLEC-China demonstration activities into their regular programme for community development. During the remainder of the project, consolidated policy recommendations will be prepared for consultation with local and national governments.

### Conclusion

PLEC has made substantial progress in all aspects of its project objectives over the past two-and-a-half years under GEF support. The project’s success is due to its decentralized networking of national-

based clusters that has assembled widely dispersed scholars and farmers to tackle the pressing global problems of biodiversity conservation and promotion of rural livelihoods in tropical and subtropical developing countries.

The innovative theme of “agrodiversity” continues to motivate PLEC members to dedicate their time to the project. The enthusiasm of local populations around PLEC demonstration sites can be capitalized upon to extend PLEC activities and influence to other areas in possible follow-up projects (now under planning). The future of PLEC thus will be built on the successful experience gained in the past.

Scientifically, El Niño is defined as a phenomenon in which warm sea surface temperatures anomalously appear in the central and eastern equatorial Pacific Ocean. The El Niño phenomenon is typically followed by a cold event, La Niña, during which the same region of Pacific Ocean is colder than “normal.” Together, these two events form a seesaw-like pressure pattern in the western part of the tropical Pacific, commonly referred to as ENSO (El Niño-Southern Oscillation).

Scientific research during the past two decades has confirmed that El Niño-related phenomena, recurring every 4½ years on the average, do indeed trigger unusual weather patterns the world over. The impacts can include droughts, fires, floods, blizzards, frosts and outbreaks of infectious diseases.

The most recent event, which started in mid-1997, rapidly developed into a strong phenomenon. Rain-producing cloud systems in the western Pacific Ocean shifted eastward, causing heavy rains at many locations in the western coastal regions of Central and South America. This also triggered drought conditions over the western Pacific and Southeast Asian region. Similar adverse climatic impacts occurred worldwide during the same time, although their relationship to El Niño is still not fully understood.

The El Niño event ended in June 1998, as unexpectedly and as rapidly as it had developed a year earlier. Sea surface temperatures in the tropical Pacific rapidly returned to normal. Then, months later, a La Niña event developed that lasted well into the year 2000. The worldwide destruction caused by this event was massive: loss of life, destruction of infrastructure, depletion of food and water reserves, displacement of communities and outbreaks of disease all occurred as manifestations of climate-related natural disasters concurrent with the 1997–98 El Niño event. Estimates of global losses range from US\$32 billion (by scientists at NOAA) to US\$96 billion (by Swiss reinsurance companies).

Policymakers, politicians and scientists the world over took notice of the impacts and realized the need for a rational strategy to cope with the damages. The UN General Assembly took expedited action and passed resolutions to develop an Inter Agency Task Force on El Niño. This task force, created in December 1997, provided a forum for sharing scientific information and for joining hands to improve general understanding of the El Niño phenomenon. A key task of the group was to focus technical assistance and capacity-building resources towards the nations threatened or affected by ENSO-related impacts.

This following is a brief overview of the lessons learned from a retrospective review of the 1997–98 El Niño episode. The study focused on 16 developing countries: Bangladesh, China, Costa Rica, Cuba, Ecuador, Ethiopia, Fiji, Indonesia, Kenya, Mozambique, Papua New Guinea, Panama, Paraguay, Peru, the Philippines, and Viet Nam. The strength of this study lies in the diversity of international partner agencies involved: US-based National Center for Atmospheric Research (NCAR), the United Nations Environment Programme (UNEP), the United Nations University (UNU), the World Meteorological Organization (WMO) and the International Strategy for Disaster Reduction (ISDR).

## Enhancing preparedness for future events

### The role of disaster management institutions and infrastructure development

Studies from the 16 countries clearly indicated that there is a strong need for developing focused disaster management institutions, and that the national governments have a key role to play in this respect. Existing institutions must review their operations during the 1997–98 El Niño event to identify strengths, weaknesses, and jurisdictional constraints and conflicts in institutional responses to the forecasts and to the impacts of El Niño.

The studies also suggest formation of an inter-ministerial task force to deal with various aspects of El Niño-related problems. This is particularly important because a number of government ministries are typically involved in El Niño-related preparedness, including those related to disaster management and climate-sensitive sectors such as agriculture, water, energy, public safety and health, as well as those concerned with economic development. Such national coordinating institutions can be helpful in reducing inter-ministerial rivalries and conflicting interests. The involvement of civil society, particularly NGOs, should be particularly emphasized to achieve effective preparedness.

The retrospective review of impacts in the 16 countries indicates that the influence was greater in regions and areas where the basic infrastructure – such as roads, railroads, canal systems, dikes, dams, grain/food storage services and medical facilities – were in a dilapidated condition to begin with. Therefore, preparedness for El Niño-related disasters can be effectively undertaken by building up national infrastructure in advance of the next El Niño.

### The importance of timely and accurate forecasts

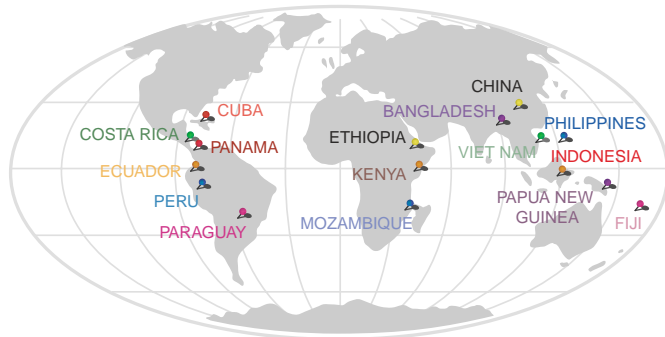
It is obvious that one needs sufficient warning time to prepare for extreme climate events. The warning comes in the form of early forecasts and predictions of adverse impacts. A study of the forecasts that were available during the 1997–98 El Niño has revealed several problems with accuracy and preciseness of forecasts as well as their specificity in describing local events. This problem was worse in developing countries, which often did not possess sufficient technical or human resources to develop their own predictions.

In some cases, the situation was exacerbated by conflicting forecasts provided by various sources, or by forecasts that predicted the opposite of the actual impacts. For example, in Costa Rica thousands of cattle were moved away from the Pacific coast to the north-central region to escape a predicted drought during 1997 – only to perish because of an unexpected drought in the resettlement area. It should also be emphasized that rarely is an entire country affected by the same climate hazard spawned by El Niño. Therefore, forecasts must be provided locally, and in a “usable” format.

The country study teams found, however, that the current scientific uncertainties in forecasting do not preclude policy makers from understanding the intrinsic value of forecasting. A wide range of available information can be used as a guide to proactive decisions involving El Niño-related disaster response and long-term sustainable development. In the aftermath of the 1997–98 El Niño, it is important that the scientific and forecaster communities undertake research and



awareness-raising to reduce the level of public skepticism about these forecasts.



The 16 countries studied under the project.

### Raising public awareness

Studies in the 16 countries point to a wide gulf between public perceptions about the impacts of El Niño and the reality. This lack of awareness often manifests itself in the form of inappropriate action or activities or, more frequently, no response at all. An indirect result of such ignorance is an absence of pressure on politicians and policy makers to take urgently-needed action. It is, therefore, imperative to undertake multidisciplinary climate-related educational efforts that enable government personnel, the public and representatives of various sectors to become more aware of these issues.

A first step towards educating people about the ENSO cycle involves “educating the educators,” who would in turn educate the public. On the positive side, increased media attention and worldwide publicity have heightened the public awareness of issues and problems. Now, the more challenging task is to develop educational programmes that are tailored to the different needs of specific users and their local conditions. The scientific community must respond to the challenge of explaining climatic processes and uncertainties to the public.

### The role of popular media

A primary function of national and international media is to inform the public, fulfilling an educational role. Forecast of the onset of the ENSO cycle and reporting on its impacts has become a major global news event. However, once the unusual weather patterns end, media interest wanes.

Fostering media interest in El Niño between extreme events can help build public understanding of the phenomena. Scientists and national meteorological services must strive to convince the media of the importance of El Niño information, and encourage them to run stories about the ENSO cycle between its extreme events.

### Sharing and dissemination of information

Collection, evaluation and dissemination of information were found to be critical components of an integrated response to El Niño-triggered climatic extremes. This information comes in many forms and shapes: scientific knowledge and forecasts about impacts, resource availability for coping with disasters, logistical arrangements undertaken by governments and international agencies, and the status of adverse impacts at regional and local levels. It is important that this

information is correct and is provided to relevant parties in a timely fashion. Coordination between governmental ministries and agencies was found to increase the effectiveness of information dissemination and its ultimate utilization.

The study also indicates that transparency in El Niño-related information dissemination can increase trust among government agencies, scientists, forecasters and the public. This requires that forecasters and researchers present an honest appraisal to governments and the media about the state of El Niño forecasting. Transparency between governments and donors is also essential, so that the needs and the expectations about disaster assistance of both are well understood.

### Regional monitoring facilities

Each of the 16 country-study teams called for improvement of weather and climate monitoring in their respective regions. They recognized the value of a well-designed network of recording stations to collect meteorological information. Great value was seen in establishment of a TAO Array-like monitoring network in the Indian Ocean, similar to the one completed in the Pacific in the mid-1990s, because changes in the Indian Ocean can influence (if not overshadow) the expected impacts in some regions.

Many governments in developing countries do not have the human and financial resources to carry out extensive monitoring and forecasting activities focused on ENSO extreme events. As a result, their meteorological services depend on the research outputs and forecasts from other countries. It is important, however, for each country and its sub-regions to develop at least the expertise to assess the forecasts that have been produced by experts in other countries. This may be achieved by developing institutions to deal with El Niño and its impacts on a regional or sub-regional basis by pooling together the limited resources available.

### Links to national and regional sustainable development

The lessons synthesized by the 16 country-study teams make it quite clear that by improving their preparedness for El Niño-related disasters, countries can reap rich benefits for their overall development. Inter- and intra-governmental coordination and infrastructure development has significant economic and social advantages. Such actions can strengthen the economy and focus on achieving sustainable development. In time, such efforts should also alleviate more fundamental social issues, such as poverty reduction or enhancement of food security.

Governments must evaluate such benefits and synergies of El Niño preparedness at regional to local scales. To achieve this, they need to encourage the study of climate-society-environment interactions. To make El Niño earliest warnings more effective, many adjustments are likely to be required in the ways that societies operate. Such societal changes might include, for example, a change of bank credit policies; a strengthening of infrastructure for transportation, communication and health; or identifying the currently at-risk populations, regions and socioeconomic sectors. Environmental degradation also must be taken into account in such assessments, because existing degradation can magnify the adverse impacts of El Niño in different locations.



### The need for capacity building

Many countries are in need of human capacity building in the area of climate impacts research and ENSO-related sustainable development and disaster planning. While the earliest of warnings can be made available to the public, education and training are required to properly interpret and use such warnings. Educators at all levels in a country's educational system should encourage students to study climate-society-environment interactions. Building national capacity with regard to climate issues can reduce a country's dependence on outside expertise for monitoring, forecasting and analysis of "externally-available" information.

Local capacity building geared toward interpreting global forecasts and analyzing them for local use is an important aspect of disaster reduction. Capacity building at the national level can create and foster multidisciplinary expertise while at the same time broadening existing disciplinary expertise. Both are needed for effective proactive participation in national as well as international activities related to climate issues (e.g., research programs, education and training activities, workshops, conferences and scientific visits).

### Key lessons to prepare for the next El Niño

El Niño and its impacts are inseparable from broader issues of climate variability and change, social and economic development, and environmental conservation. This underscores the importance of a concerted effort on the part of governments and non-governmental organizations to continue research into climate variability, improve forecast skills, and develop appropriate policies for mitigating the impacts of climate extremes.

Some of the key lessons from this study are summarized here:

- Intervention at the highest level of government is needed to catalyse an appropriate level of response, as was the case in several countries' response to El Niño in 1997–98 (e.g., Peru, Ecuador, Viet Nam, the Philippines and Ethiopia). Additionally, well-defined emergency management structures are needed in

most developing countries.

- All the 16 countries studied lacked adequate human and financial resources for national monitoring and forecasting of extreme climate events spawned by El Niño. The top priorities for capacity building are training researchers to identify a country's "at-risk" populations and educating the at-risk public in preparedness for El Niño-related disasters.
- The reliability of El Niño-related forecasts at the local level needs improvement to a point where government agencies will take them much more seriously.
- A network of floating meteorological data recording stations monitored by satellite is needed in the Indian Ocean to help Africa and the Asia-Pacific region better forecast El Niño's influence on weather-related problems. At the moment, the impacts of El Niño in eastern Africa are not well understood, a situation that is further compounded by a lack of detailed, local forecasts.
- In geographically diverse countries (like Indonesia), it is important that each region should issue its own forecasts relevant to the local micro-climate.
- El Niño can magnify existing problems. In countries with social and political unrest and/or poor infrastructure, the focus should be on developing and maintaining the necessary infrastructure, and identifying the populations most vulnerable to El Niño and its impacts.

The UN agencies are partnering with the National Center for Atmospheric Research (NCAR) to develop a comprehensive programme of "educating educators" in developing countries. This effort will particularly address the science, policy and ethics related to climate change, variability and extremes. The UNU, in partnership with NCAR and WMO and with support from ISDR, is seeking donor support to fully develop such a programme. W



The destruction caused by El Niño in Viet Nam.

Source: Dr. Nguyen Huu Ninh, Centre for Research and Development (CERED), Hanoi, Viet Nam

# Food Security: Using Ethnobotany Information to Target Conservation and Genetic Improvement of Indigenous Leafy Vegetables in Nigeria

By J.J. Baidu-Forson and Folu May Dania Ogbe\*

Food security is a major challenge facing Africa as we begin a new millennium: more than 40 per cent of the continent's population is "food insecure." Africa is the only continent where both the absolute number and percentage of chronically malnourished population has continued to grow. Even for people who have access to food, diets are invariably characterized by disproportionately large intakes of carbohydrates.

Yet, across Africa's diverse ecology, indigenous leafy vegetable crops exist that are important sources of protein, minerals and vitamins (A, B complex and C). The consumption of indigenous leafy vegetables, in stews or soups, is firmly rooted in the eating habits of the peoples of sub-Saharan Africa. Leafy vegetables collected from the wild (e.g., watercourses, fallow lands, and isolated areas) also represent important sources of food security to rural Africans during droughts, famines and wars. Women typically cultivate other types of indigenous leafy vegetables in intercrops and small plots near farm households. However, much of the intensive vegetable farming, especially in peri-urban agriculture, involves the cultivation of well-researched introduced vegetables.

The continued survival of many indigenous leafy vegetables is threatened by rapid population growth; the corresponding increase in demand for arable land leads to the cultivation of marginal lands where the leafy vegetables predominantly grow. The threat of extinction of some indigenous vegetable species is heightened by deforestation, overgrazing by livestock and bush fires.

Because indigenous leafy vegetables are better able to withstand the harsh climatic and disease stresses that are characteristic of tropical Africa and can significantly improve the nutritional status of food-insecure rural families, urgent action to rescue them and prevent the loss of biodiversity is imperative. An important step in the achievement of this goal is to conduct ethnobotany research to:

- compile an inventory of useful indigenous and underutilized leafy vegetables;
- develop a database on the patterns of variation and utilization of identified indigenous leafy vegetables;
- document traditional knowledge regarding utilization, management and production systems;
- evaluate the nutritional qualities of each species; and
- identify those economic and cultural factors that constrain development and expansion of the use of the indigenous leafy vegetables.

Ethnobotanical surveys can result in the identification of preferred traits that should be enhanced in species to improve prospects for widespread production and consumption. In addition, in the absence of documentation, the current rapid pace of social and cultural change in Africa may lead to the loss of indigenous knowledge on the local plants. Plant diversity studies can identify losses as well as genetic erosion and provide a basis for rescue collection missions and

effective conservation strategies.

The United Nations University Institute for Natural Resources in Africa (UNU/INRA) has launched an ethnobotany field survey focused on women, who mostly harvest indigenous leafy vegetables from the wild and are custodians of traditional knowledge on the management, preparation, use and sale. A multidisciplinary team of scientists surveyed some 50 sites across six states of southwestern Nigeria. The research involved administering a structured questionnaire to 200 key informants per study site, carrying out direct field observations making contacts with farmers, and conducting herbarium surveys and greenhouse and field studies.

Preliminary findings include the identification of 25 indigenous plants (trees, shrubs and herbs) whose leaves are used as vegetables. These plants are unevenly distributed across the different ecological zones, with the highest diversity occurring in lowland rainforest. The most widespread leafy vegetable plants in the lowland rainforest are *Amaranthus* sp., *Telfairia occidentalis*, *Vernonia amygdalina*, *Corchorus olitorius*, *Celosia argentea*, *Solanum* sp. and *Ocimum gratissimum*. The first three are of economic importance in the study areas. With the exception of *Corchorus olitorius* and *Celosia argentea*, most of the common leafy vegetable plants of the rainforest are also found in the savanna ecology. *Ipomea mauritiana* and *Sesuvium portulacastrum* are rare leafy vegetable plants that occur in the mangrove ecology. Variations between and within species were observed for several of the indigenous vegetable plant species.

Research and development of indigenous vegetable plants are hindered by a number of factors, such as:

- the large number of species involved;
- difficulties in conducting conventional agronomic studies; and
- the low status accorded the vegetables.

A key recommendation by African academics and scientists is to focus on prioritization of indigenous plants to determine about 4 or 5 important species to be selected for genetic improvement and application of improved horticultural propagation methods to enhance their production, processing, commercialization and widespread utilization. The UNU/INRA field surveys were conducted to provide guidance on the vegetable leafy plants and species that should be selected for in-depth greenhouse, laboratory and agronomic studies. Subsequent greenhouse and agronomic studies are being targeted at genetic enhancement, propagation improvement, and identification of agronomic conditions for increased productivity. Planned laboratory studies will focus on generating a database on nutritional and other properties of the selected indigenous leafy vegetables.

This information will bring to the fore the value of indigenous leafy vegetables to the Nigerian (and, more generally, the African) food base. The results of these studies will stimulate or motivate the rescue and on-site and off-site conservation of indigenous leafy vegetables and their continued propagation to enhance the food security of Nigerians in particular, and of sub-Saharan Africans in general.

\* This essay draws on the project *Ethnobotany of Indigenous African Food Crops and Useful Plants: Leafy Vegetables of Southwestern Nigeria*, part of an Environment Project on the Conservation of Biodiversity, Genetic Improvement and Increased Utilization of Africa's Indigenous Food Crops and Useful Plants, directed by Folu M. Dania Ogbe.

# Sustainable Use and Conservation of Natural Resources in the High Pamir Mountains of Central Asia

By Hans Hurni and Libor Jansky

As in all former Soviet Union territory, the transition to a market economy has led to profound changes also in Central Asian countries. Mountains, which are the most marginal areas in these countries, have been particularly strongly affected by the economic and social transformation processes.

The High Pamir mountains are a noteworthy case in point, as they constitute the meeting point of six countries: Afghanistan, China, India, Kyrgyzstan, Pakistan and Tajikistan. Promoting sustainable development in these mountains will be a great challenge from strategic, political, economic, social and ecological points of view. It is for these reasons that the United Nations University's Global Mountain Partnership Programme<sup>1</sup> (UNU GMPP) has included the Pamir Mountains as an area of particular concern. GMPP is currently preparing a comprehensive research and development programme for this mountain system in Central Asia, and is approaching various agencies to seek financial and technical support.<sup>2</sup>

The High Pamir mountains lie mainly in Tajikistan and constitute about 50 per cent (some 70,000 sq km) of that country's territory. The mountains' northern chains form Tajikistan's northern border with Kyrgyzstan. Because of the location and extent of the High Pamir mountains, their extreme bio-physical conditions and high altitudes (3,000 to 7,400 meters), their special arid to sub-humid climatic regime, and their scarce vegetation and unique fauna, Tajikistan declared part (about 15,000 sq km) of the mountains a National Park in 1992–93. Establishment of this National Park, however, is still underway.

The government of Tajikistan has identified the Pamir mountains as an area of highest importance in its "State of the Environment Report." Indeed, the region is under stress due to conflicting and particularly damaging uses of flora and fauna, creating an urgent need to develop and implement a major set of management structures geared towards conservation and sustainable use of natural resources.

Because the Pamir mountains form a border with Kyrgyzstan, the development of transboundary management agreements are considered important in that country as well. In view of damaging environmental practices introduced after 1991, the adaptation of the livelihood systems of the local inhabitants in the high mountain area constitutes a particular challenge. A viable option to be considered may be the improvement of equitable income-generating schemes through sustainable use of wildlife and other natural resources.

The local inhabitants of the High Pamir – about 50,000 people of Kyrgyz ethnic descent – were "sedentarized" during the Soviet period, compelled to abandon their former transhumance grazing

## Mountain-related events co-organized by UNU in 2000 were:

- First International Conference on Global Mountain Biodiversity Assessment, Rigi/Kaltbad, Swiss Alps, 7–10 September 2000 (<http://www.unibas.ch/gmba/index.html>)
- Fifth International African Mountains Association (AMA) Conference on African Mountains as Water Towers, Lesotho, South Africa, 16–20 October 2000
- International Symposium on the Himalayan Environments: Mountain Sciences and Ecotourism/Biodiversity, Kathmandu, Nepal, 24–26 November 2000 (<http://www.unu.edu/env/mountains/himalayan-environments.html>)

systems for perennial residence in small towns located at altitudes of 3,400 to 3,600 meters. After the transition of the early 1990s, these people lost all government subsidies and have since been experiencing a very serious economic bottleneck. Their attempts to earn a living through sales of livestock, substitution of local woody biomass for coal, and intensified grazing of scarce riverine vegetation (especially during the extended non-vegetative winter period), are leading to an extreme degradation of parts of the local flora. Some woody species are expected to disappear completely within the next few years.

While increased hunting of wildlife by sport hunters (particularly from the North American continent) is a source of income for local guides, organizers of hunting expeditions and the State, this use of a natural resource does not benefit the population at large. Improved management will require that government institutions, large NGOs in the region, enterprises and local populations be fully recognized as stakeholders, with a view to developing viable systems targeting better livelihoods for local residents and sustainable use of natural resources.

The aims of the project<sup>3</sup> that UNU GMPP intends to develop jointly with numerous other agencies are to:

- provide a better baseline on the environment and the people in the area,
- assess and appraise current institutional set-ups and performance,
- develop options for improving aspects of conservation and sustainable resource management by the various stakeholders involved, and
- provide some immediate support.

A final objective of these preparatory actions will be to develop a full-scale project once sufficient information and management options have been generated. Experience gained during a preparatory mission

1 For more information, see <http://www.unu.edu/env/mountains/>.

2 The institutions that potentially may be involved in the preparations of a project in the Pamir Mountains are (tentative list): the Agence d'Aide à la Coopération Technique et au Développement (Murgab, Pamir), Aga Khan Development Network (Geneva, Switzerland), Centre for Development and Environment, University of Berne (Switzerland), Global Environment Facility (Washington, DC, USA), International Union for the Conservation of Nature and Natural Resources (Gland, Switzerland) Naturschutzbund Deutschland e.V. (German Society for Nature Conservation; Bonn, Germany), United Nations Convention on Biological Diversity (Montreal, Canada), United Nations Convention to Combat Desertification (Bonn, Germany), United Nations Environment Programme (Nairobi, Kenya), United Nations University (Tokyo, Japan) and World Wide Fund for Nature (Gland, Switzerland).

3 This project concept was proposed by the Central Asia Mountain Partnership (CAMP) Programme, a member of UNU GMPP, under the leadership of Prof. Dr. Hans Hurni, principal co-ordinator of UNU GMPP at the Centre for Development and Environment (University of Berne). The proposal was developed in association with ACTED (Agence d'Aide à la Coopération Technique et au Développement), an NGO active in the High Pamir, and is based on ideas developed by Tajikistan's Ministry of the Environment.

to the High Pamir in June 2000 showed that a multi-level appraisal of the status and trends of the fauna and flora in the area would create the necessary awareness among institutions and local populations as well as a baseline to develop integrated management schemes and support systems for the conservation and sustainable use of natural resources. Immediate measures are needed to safeguard vital woody biomass resources in the high mountain areas, and would have to be devised accordingly.

The objectives of the proposed project, therefore, will be to produce:

- (a) a comprehensive, geo-referenced baseline database of the High Pamir mountains both in Tajikistan and Kyrgyzstan, including information on natural resources (flora and fauna), people, institutions and current management systems;
- (b) a set of options based on stakeholder negotiations regarding needs, opportunities and constraints as seen by local resource users as well as by external users and institutions; and
- (c) viable inputs for a larger project in biodiversity conservation in the transboundary Pamir area.

On the policy side, appropriate legal and institutional frameworks will be proposed. On a conceptual level, the project will benefit from the application of a transdisciplinary methodology, with local members of the project team trained accordingly.

In terms of activities, the project would, as an immediate measure, secure the availability of coal on the local markets in highland towns to help preserve the last remaining woody biomass in the area. Other activities would include:

- establishing baseline information by carrying out participatory field work and applying a Sustainable Development Appraisal (SDA) in selected “hotspots” of the High Pamir mountains;

- promoting sustainable development by organizing multi-level stakeholder negotiations to achieve joint visions on conservation and sustainable development in the area;
- supporting monitoring and planning by developing a Geographic Information System (GIS) and remotely sensed data to provide an overview of the entire area of intervention;
- promoting conservation by carrying out surveys of major wildlife threatened by legal and illegal hunting, and developing management planning options for national parks and controlled hunting areas; and
- providing support for follow-up activities, including developing recommendations for further action in the area through policies, external support, local empowerment and the building of capacity and competence.

Attempts will be made to include the following stakeholders in project design and implementation:

- At the local level, selected representatives of the different socio-economic categories and employment sectors will be invited to participate in negotiations.
- At the regional level, representatives of NGOs and government agencies will be involved in defining immediate measures and in carrying out the Sustainable Development Appraisals in “hotspot” areas.
- At the national level, professionals from appropriate institutions will be given opportunities to join the field work carried out by the executing agency in their respective countries, with the option of mutual visits.
- At the international level, the scientific networks of UNU will be used to secure the most suitable resource persons for supervising the work of the field teams.

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## An overview of UNU GMPP

The UNU Global Mountain Partnership Programme (UNU GMPP) has been designed in line with the goals of the International Year of Mountains (2002), which was proclaimed by the UN General Assembly in November 1998. Emphasis is placed on networking and capacity building in the developing and transition countries, making preparations for a sustainable mountain development partnership programme, and disseminating information on issues related to sustainable mountain development. The UNU GMPP seeks to link existing projects. It emphasizes interaction between academic excellence and policy development, and is open to partners who conform with certain basic criteria, such as: mountain focus, interdisciplinary to transdisciplinary approach, capacity building and empowerment activities.

Capacity building is a major focus of the programme. In addition to training efforts, important tools for this are the regional mountain associations, the African Mountain Association and the Andean Mountain Association, established with the assistance of UNU. The main hard-copy communication instrument for the project is the journal *Mountain Research and Development* (<http://www.mrd-journal.org/>).

This project is being implemented jointly by UNU and the Centre for Development and Environment (CDE) University of

Berne, Switzerland. It is undertaken in close collaboration and co-ordination with other actors involved in the field, including FAO, the Andean Mountain Association (AMA), the International Centre for Integrated Mountain Development (ICIMOD), and the Mountain Institute (TMI). Specific project activities include:

- To assist in preparations for the International Year of Mountains in 2002, programme members will make substantive inputs to UN system-wide efforts in sustainable mountain development by participating in a number of preparatory meetings. Programme co-ordinators will represent UNU in the Inter-Agency Group on Mountains for Agenda 21 Chapter 13, which meets regularly, and in UN Commission on Sustainable Development (CSD) meetings.
- In 2000, an international working group of mountain experts and representatives of mountain countries negotiated and has worked towards a new, to-be-established project relating to sustainable mountain development partnerships.
- The project will support the development of regional networks and research efforts in developing and transition countries, with specific emphasis given to Africa, the Andes, the Himalayas (including Central Asia), and the mountain and highland areas of southwest China.

# Establishment of a Directory of Women Professionals in Natural Resources in Africa

By J.J. Baidu-Forson, Ellen Bortei-Doku Aryeetey, A.U. Mokwunye and Alexina Arthur<sup>1</sup>

Agenda 21 of the United Nations Convention on Environment and Development (UNCED), contained in the deliberations of the Rio Summit of 1992, and the Platform for Action emanating from the Fourth World Conference on Women in 1995 recognized the role of women as managers of natural resources and recommended their full participation in development activities. As a contribution to the implementation of these recommendations, the United Nations University Institute for Natural Resources in Africa (UNU/INRA) began a project in 1998 to prepare a comprehensive list – including brief profiles, qualifications and experience – of African women professionals involved in the conservation, management and utilization of natural resources. The project is designed to provide a reliable database that can be easily searched by international, multilateral and bilateral agencies, and non-governmental organizations looking for professional women in all areas of natural resources.

This directory will serve many functions. For example, the Consultative Group on International Agricultural Research (CGIAR) has a Gender and Diversity Program aimed at attracting more professional women from all regions of the world into the CGIAR group of research institutes.<sup>2</sup> The UNU/INRA database on women professionals in natural resources provides invaluable opportunities for the CGIAR system to locate and engage African women who are well placed to effectively empower their fellow women to act in the management, conservation and utilization of natural resources. It will also facilitate the recruitment of women professionals by UN agencies (including FAO, UNDP, UNIFEM, UNEP, INSTRAW, UNESCO and other UNU research and training centres and programmes) as well as international and bilateral development agencies (such as USAID and DANIDA) that have extensive development programmes in Africa. The skills of these professional women can then be used to reach other women who manage and use natural resources, offering opportunities that make them equal partners in development as envisaged in the “call to action” in the Agenda 21 of UNCED and the Fourth World Conference on Women.

Pursuant to UNU/INRA’s cross-cutting focus on gender, and to give meaning to the “call for action” contained in the outcome of the two conferences, a five-member Advisory Panel of African women was convened to:

- consider the multiple roles of women in natural resources development;
- identify the major problems women face in natural resources management for sustainable development in Africa; and
- recommend priority areas of research, training and information dissemination as well as strategies to alleviate the problems and

constraints experienced by women.

A key recommendation of this Advisory Panel is that UNU/INRA should compile a directory that briefly reviews the profiles and accomplishments of African professional women in natural resources. The overall objective of preparing this directory is to lay the foundation for a database on women professionals for easy reference and use in planning, project design and implementation, and policy formulation in natural resources management and conservation.

The specific objectives of the project are to:

- bring together, in one publication, information on African women professionals that is currently scattered in handbooks on membership of professional associations/academies/universities;
- produce a directory that includes brief profiles and other information dealing with the experiences and activities of African professional women in natural resources for use by UNU/INRA in planning its research and training programs;
- create a database that can be disseminated and used for information exchange, conference planning and manuscript reviews; and
- provide a source of information for use by African governments and international organizations/agencies seeking to appoint women as consultants or resource persons on women-related issues or development activities.

The project is being carried out in phases. The first phase, completed in the 1998–1999 biennium, covered eight countries: Botswana, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Niger, and Zambia. Additional data was collected from professionals from several other African countries at conferences. Phase 2 of the data collection, which is ongoing during the 2000–2001 biennium, involves sub-regional Focal Point Managers and local collaborators (including university lecturers, seasoned researchers, private consultants and a Minister of State).

Currently, the directory contains records on 811 women professionals in natural resources from 15 countries: Botswana, Cameroon, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mozambique, Niger, Nigeria, Senegal, South Africa, Tanzania, Uganda, and Zambia. The database will soon be posted on the UNU/INRA homepage<sup>3</sup> in a format suitable for downloading or online consultation. This will be a “live” document that is constantly updated and augmented with new data.

The database includes such information as personal data, contact address, level of education, qualifications and areas of specialization. Areas of specialization represented in the database include biology (aquatic biology, molecular biology, botany and biological sciences); agriculture (various disciplines); biochemistry and chemistry; biodiversity conservation; energy; nutrition (human and livestock); forestry; gender and science; home economics; information technology; and palaeontology. The great diversity of specialization among African women professionals in natural resources confirms the immense potentials for using their services to design gender-sensitive programmes and actions.

<sup>1</sup> This article draws on the project *Preparation of a Directory of African Women Professionals Involved in Natural Resources Conservation and Management: Their Brief Profiles, Record and Experiences*, part of an Environment Project on the Conservation of Biodiversity, Genetic Improvement and Increased Utilization of Africa’s Indigenous Food Crops and Useful Plants coordinated by Ellen Bortei-Doku Aryeetey (Phase 1) and Alexina Arthur (Phase 2).

<sup>2</sup> Merrill-Sands, D., J.K. Fletcher, A.S. Acosta, N. Andrews and M. Harvey, *Engendering Organizational Change* (1999, CGIAR Gender Program Working Paper No. 21, CGIAR Secretariat, World Bank, Washington, DC).

<sup>3</sup> <http://www.unu.edu/inra>

# The Role of Forests in Sustainable Development – An Ongoing Pilot Project

By Matti Palo

The purpose of this United Nations University pilot project by UNU is to design joint research projects to support sustainable forest management in a partnership within the World Forests, Society and Environment Research Programme, and to disseminate research findings produced by this programme. The ultimate goal is to conduct targeted research, and to support networking and capacity building on the role of forests in sustainable development in developing countries and economies in transition.

This project progress report introduces the framework of the programme, the ongoing pilot project context and objectives, and the implementation of the various tasks of the pilot project.



Participants of the UNU/WFSE Research Strategy Workshop discussing reforestation activities with the representative of the Foundation for the Development of the Central Volcanic Range in Costa Rica (Photo: Libor Jansky, UNU)

## WFSE Research Programme

The World Forests, Society and Environment (WFSE) Research Programme was mobilized in 1996 by the Finnish Forest Research Institute (METLA), United Nations University/Institute of Advanced Studies (UNU/IAS) and European Forest Institute (EFI). In 2000, the UNU Headquarters replaced UNU/IAS as one of the three partners of WFSE. Five leading international forest research institutions have joined WFSE as Associate Partners: the Center for International Forest Research (CIFOR; Indonesia), International Centre for Research in Agro-forestry (ICRAF; Kenya), Center for Research and Higher Education in Natural Resources in Latin America (CATIE; Costa Rica), World Forestry Center (WFC; United States) and Institute for World Forestry (Germany).

The mission of WFSE is globally relevant research and human capacity building on forests, society and environment in support of sustainable forest management and the well-being of people. This mission is implemented by an international core team located at METLA in Helsinki, Finland, in cooperation with the seven partners and other cooperating bodies worldwide. The Scientific Advisory Board of WFSE, chaired by Professor Alexander Mather of the University of Aberdeen, Scotland, has 18 members from five continents. The board guides WFSE activities, and its members act as referees for articles to be published.

WFSE has adopted a number of strategies in cooperation with its partners:

1. It thrives in increasing joint globally relevant research by designing new project proposals for external funding under the guidance of the Scientific Advisory Board.
2. WFSE edits, publishes and provides an outlet for its partners in "World Forests" books and similar other global traditional and electronic publications.
3. WFSE is intensifying networking among its partners, members of the Scientific Advisory Board, sponsors, authors and other collaborators via Internet services, such as a Web site, an online

newsletter and discussion forum, and e-mail.

4. WFSE will increase dissemination of its research findings and extension and human capacity-building activities, especially in developing countries and economies in transition.
5. WFSE aims to increase the exchange of researchers, research findings and data among its partners.

So far WFSE has created its reputation primarily by making five globally relevant books. Three of these books have been published as volumes I to III of the World Forests book series<sup>1</sup> by Kluwer Academic Publishers. One has been published as part of the World Development Studies series<sup>2</sup> by UNU/WIDER and one by WFSE<sup>3</sup>.

## UNU/WFSE pilot forest project

The pilot forest project will build on the research findings, the core team, the Scientific Advisory Board and networking of WFSE. The project will contribute to the Agenda 21, Chapter 11 (Combating Deforestation), the Convention of Biological Diversity, the Convention on Desertification and the UN Framework Convention on Climate Change. It will incorporate the proposal for action by the Intergovernmental Forum on Forests, and will particularly focus on improving linkages between forest science and forest policy processes at global, regional and national levels. The project leads also towards

- 1 Palo, Matti and Jussi Uusivuori (eds.), *World Forests, Society and Environment* (1999).  
Palo, Matti and Heidi Vanhanen (eds.), *World Forests from Deforestation to Transition?* (2000).  
Palo, Matti, Jussi Uusivuori and Gerardo Mery (eds.), *World Forests, Markets and Policies* (2001).
- 2 Palo, Matti (ed.), *Forest Transitions and Carbon Fluxes. Global Scenarios and Policies* (1999).
- 3 Michie, Bruce and Stephen Kin, *A Global Study of Regional Trade Flows of Five Groups of Forest Products* (1999).



the International Year of Mountains (2002).

The objectives of the project are:

- to jointly develop, with WFSE and other interested parties, research and capacity-building proposals to enhance WFSE Research Programme activities and outputs.
- to strengthen the human capacity in international forest research by disseminating research results from WFSE at international conferences and workshops, and by other means.

#### Proposal of a joint research project

In April 2000, a pilot project on the role of forests in sustainable development was launched within the framework of WFSE and based on funding by UNU and METLA. A joint research project proposal, titled "Investments and Trade in Support of Sustainable Forest Management in Developing Countries," was prepared and submitted to the INCO-DEV-Research Programme by the European Union in September 2000. Twenty-five universities and research institutions in eleven developing countries and nine member countries of the European Union participated in the proposal.

#### WFSE meeting at IUFRO-Congress

In August 2000, a WFSE satellite meeting was organized at the world congress of the International Union of Forest Research Organizations (IUFRO) in Kuala Lumpur, Malaysia. The purpose of the evening meeting was to introduce the WFSE programme and key findings to IUFRO congress participants, identify joint research priorities for 2000–2004 and strengthen the partnership of WFSE.

WFSE researchers introduced WFSE's past achievements, organization and fresh research findings. Ongoing WFSE research concerns the following themes: (a) tropical deforestation modeling of the underlying causes, scenarios and policies of global forest cover changes and carbon fluxes; (b) globalization of forest industries and forest politics; (c) international trade and direct foreign investments in forest products; and (d) forest policies and development. The meeting was ended with a panel discussion by the leaders of the WFSE-partners, all of whom promised to strengthen cooperation in WFSE. The diversity of the partners will allow varying coalitions for joint research.

#### UNU conference on "Value of Forests"

In October 2000, I was invited as a keynote speaker to the international conference on "Value of Forests," organized by UNU with many collaborators in Tokyo. The conference had 200 participants. The title of my address was "The Political Value of World Forests."

In a decade, the value of forests in the general global political agenda has been strongly increased, both within UN and G8 frameworks. Although so far more rhetoric than effective action has prevailed, the fresh high political value of forests provides an option for innovative initiatives at both the international and national levels.

A WFSE/UNU planning session was also convened. It was found that the Global Environmental Facility (GEF) is not a relevant external funding source for WFSE project proposals.

#### WFSE/SAB meeting in 2001

The new Scientific Advisory Board of WFSE will have its first meeting from 30 January to 4 February 2001 at CATIE, in Turrialba, Costa Rica. The overall objective is to further advance the strategies and joint globally relevant research for the next five years, as built on the experiences of the past five years by WFSE. The board will discuss changes in the organization and future research orientation of WFSE and plan new joint research projects. The contents of a new volume in the World Forests book series, tentatively titled *World Forests, Financing, Trade and Development*, will also be discussed.

#### Conclusion

The UNU/WFSE pilot project on the role of forests in sustainable development has already proved its value by facilitating further planning of joint WFSE project proposals and dissemination of new WFSE-research findings. UNU Headquarters, by joining WFSE as a full partner, has brought additional consolidation to this unique global Research Programme on World Forests, Society and Environment.

WFSE is looking optimistically forward to new avenues in research, human capacity building, and networking for developing countries and economies in transition. We feel proud and privileged to cooperate with UNU. w



Social dimension of forest ecosystems – Western Carpathians  
(Photo: Libor Jansky, UNU)

# Hunting for Endocrine Disruptors in East Asian Waters: Synopsis of a UNU Regional Project

By Zafar Adeel

## Endocrine disruptors as a major pollution threat

Chemical pollutants considered to possess endocrine-disrupting properties have received increasing attention from the general public, policy makers and scientific community alike. An endocrine disruptor compound (EDC) can be any chemical that interferes with or interrupts metabolic, growth and reproductive hormonal functions in animals and humans.

Scientific research in the past decade has highlighted several groups of chemicals that mimic hormones or disrupt their activities. The major classes of these EDCs include organo-chlorine compounds; pesticides, fungicides and herbicides; organometallic compounds; phytoestrogens and synthetic estrogens; and surfactants and high-volume industrial chemicals. Currently, about 50 chemical compounds are established as disruptors of the hormonal systems of affected animals and humans. Many more compounds – up to 15,000 – are currently under scrutiny for possible EDC-like effects.

It is believed that various EDCs are present in significant quantities in the environment and are having adverse impacts on the health of humans and ecosystems. A major challenge in dealing with EDCs is that they persist in the environment for long periods of time and resist natural degradation processes. The most common result of this persistence is that EDCs accumulate in the environment in increasing levels through the food chain. This accumulation puts predators at the top of the food chain, including humans, at a higher risk.

While it is well accepted that at very high dosages these EDC compounds can cause adverse hormonal effects, their impact on recipient species at relatively low levels is not clear or completely understood. Scientists are actively and rigorously trying to understand the actual mechanisms involved. Recent research on animal populations has revealed that several fish, avian, reptilian, and mammalian species are suffering adverse health effects from exposure to chemical pollutants that are suspected to interact with the endocrine system, most commonly organo-chlorine compounds (such as DDT, polychlorinated biphenyls (PCBs) and dioxins) and some naturally occurring estrogens.

Policy makers who deal with environmental policy have also reacted in response to the available scientific information and the public pressure to take action. The underlying approach is a “precautionary principle”: it is not essential to have absolutely perfect scientific information to take action proactively. Within the United Nations system, formulation of a treaty on persistent organic pollutants (POPs) has clearly been driven by the debate on EDCs and their impact on the environment.

## EDCs in coastal areas

Coastal zones, approximately 40,000 km in length worldwide, are particularly vulnerable to human influences and are at risk of EDC pollution from marine- and land-based sources. These are also the areas where urban growth is fastest, resulting in excessive stress on the natural resources. Encroachment of human activities by way of building, changing land-use, tourism, and pollution from both



Impacts of EDCs on birds

Source: Prof. D. Michael Fry, University of California, Davis

industry and agriculture strains the natural coastal ecosystems. In particular for the developing countries, this growth is rapid and difficult to manage due to relatively uncontrolled population growth, limited infrastructure and insufficient financial and manpower resources. In general, there is high potential that coastal areas in East Asia are heavily impacted by EDCs. Selective monitoring of the environment, such as the Asia Pacific Mussel Watch programme, has shown that this indeed is true.

In most cases, coastal and marine areas act as the ultimate sinks for EDC pollutants. Marine sources of pollution are mostly linked to the shipping industry and related activities, including oil spills. However, the greater bulk of EDC pollutants can be attributed to land-based sources. A wide range of industrial sources, including manufacturing, wood treating, plastics, pharmaceuticals and agricultural chemicals, can contribute towards introduction of EDCs into the environment.

Cities can be a major source of pollution to coastal areas, particularly those in proximity to the coastline. Wastewater output from cities is a major problem, particularly in developing countries where effluents are typically either not treated or treated ineffectively. For example, synthetic estrogen used in birth control pills is often found in urban wastewater. Excessive use of pesticides and herbicides

in agriculture has also led to introduction of chemical pollutants, several of which are known to have endocrine-disrupting properties, into the environment.

### International monitoring by UNU and its partners

The UNU has adopted an approach of focusing on coastal areas as a critical and high-priority ecosystem. The UNU has initiated a monitoring programme in nine East Asian countries since 1998: China, Indonesia, Japan, the Republic of Korea, Malaysia, the Philippines, Singapore, Thailand and Viet Nam. Because these countries are linked geographically and often face similar challenges in managing coastal resources, coastal management programmes should be somewhat consistent.

This programme is named “Environmental Monitoring and Governance – EDC Pollution in the East Asian Coastal Hydrosphere.” *Coastal hydrosphere monitoring* includes monitoring of both freshwater- and seawater-pollution in the coastal areas. The targets of this monitoring are compounds originating from land-based sources that are suspected to be EDCs.

Reliable regional data in East Asia are either non-existent or difficult to access. The UNU project, therefore, aims at developing a regional database while facilitating the transfer of technology and knowledge to participating laboratories. This technology transfer and capacity building is, in part, done through specialized training and hands-on experience. At the same time, the network of researchers developed in this project acts to enhance regional co-operation and promote the exchange of data and monitoring results. The data collected under this programme are compiled and disseminated from LandBase,\* a Web-based GIS interface for information presentation. It is anticipated that the information contained in LandBase will be used to develop guidelines for a regional coastal management programme.

### The monitoring programme

At present, three groups of chemicals are being targeted within the programme: DDT and its breakdown compounds; alkylphenols and bisphenol-A; and phthalates. Current monitoring includes the first two groups, with the third to be added next year. The selection of these chemical groups is based on available scientific information for endocrine disruption effects, use and presence in the East Asian region, and the analytical capacity of the partner institutions.

Most important of the three groups is the first, because DDT is still produced in substantive quantities in the region. Although its agricultural use is banned in almost all the countries, its use for vector control and public health purposes is not restricted. As a result, significant concentrations of DDT (and its breakdown compounds) have been found in sediments and waters in riverine and coastal areas.

The monitoring programme for each country is tailored to that country's own specific conditions pertaining to geography, climate patterns, and location of urban, industrial and agricultural areas. The sampling locations are selected such that they are helpful in identifying potential land-based sources. The samples collected as part of the programme are delivered to laboratories within the partner institutions in accordance with standard procedures. The UNU, in collaboration with experts from Shimadzu Corporation, has developed easy-to-follow analytical procedures that are in accordance with the available equipment. The data generated from the analytical procedures are critically reviewed by the UNU to ensure data quality.

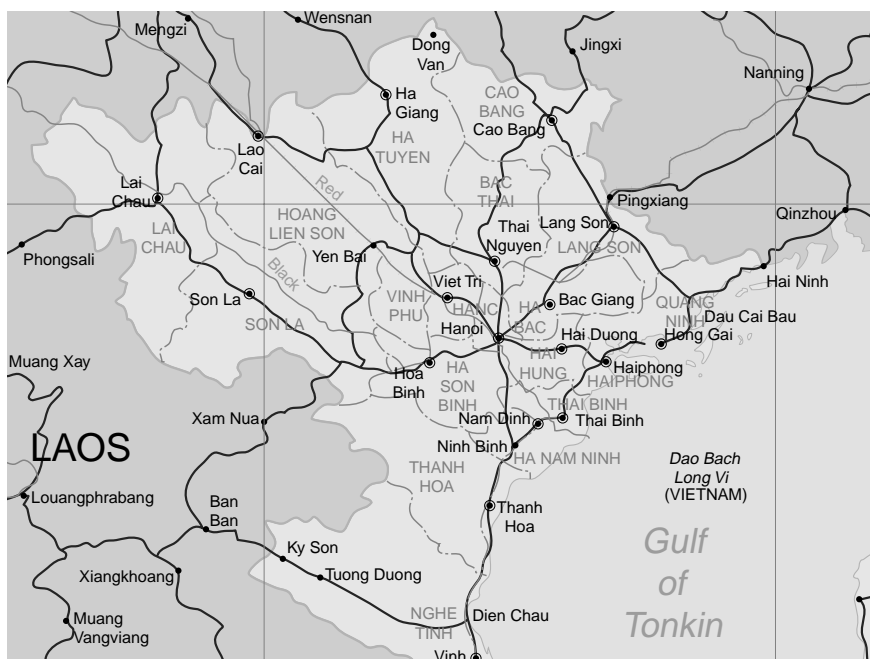
### Key challenges in hunting for EDCs

This monitoring programme has to overcome a number of challenges in achieving an effective design and successful implementation, particularly within the limited human and financial resources available. Some of the major challenges are:

- selecting appropriate sampling locations,
- ensuring data quality and consistency in analysis/reporting,
- interpreting data and evaluating seasonal/spatial variability,
- dealing with limitations of financial and human resources, and
- defining policy guidelines based on data interpretation.

### Case studies

The following two case studies from the UNU monitoring programme highlight the challenges and the success achieved. These case studies, focusing on the Red river basin in Viet Nam and the Selangor river basin in Malaysia, were conducted by research teams led by Dr. Pham H. Viet (Vietnam National University, Hanoi) and Dr. Mohammed Mustafa (University of Malaya, Kuala Lumpur), respectively.



Map of Viet Nam showing the Red river

\* <http://www.geic.or.jp/landbase/>.

### Red river basin (Viet Nam)

The Red River is a major river in Thaibinh province of Viet Nam; it flows into the Balat Estuary, approximately 100 km southeast of Hanoi. Together, the Red river basin and the coastal area comprise an important rice-producing region. Typically, substantial quantities of pesticides and herbicides are used in this region.

Water samples were collected from several locations, eight of which were inland in the proximity of Hanoi and five of which were in Balat estuary. Sediment samples were also collected from selected locations to match with water samples. Sampling was carried out during the rainy season (July 1999) and dry season (January 2000). The data for cumulative p,p'-DDT are shown in Table 1, with sampling points 1 through 13 sequentially representing downstream locations from inland on the Red River to the Balat Estuary.

Table 1. Concentrations of  $\Sigma p,p'$ -DDT in water samples (ng/L) and sediments (ng/g dry wt.)

Sampling stations (sample ID)	Water samples		Sediment samples		Comments
	Dry Season	Rainy Season	Rainy Season	Dry Season	
1 (H5)	3.3	2.8		21	<< Influx from Duong River
2 (H4)	2.9				
3 (H3)	9.0				
4 (H2)	7.8	3.0		40	
5 (H1)	7.5				
6 (H6)	2.1				
7 (H8)	4.7				
8 (H12)	4.8	3.2		7.4	
9 (H13)	2.5	16		55	Various locations on Balat Estuary
10 (H14)	5.4				
11 (H17)	2.4				
12 (H18)	2.4	15		52	
13 (H19)	2.2				

As can be seen from Table 1, a major spike in water concentrations of DDT is observed at the point where Duong River merges into the Red River. This influx is likely correlated with rice cultivation in Thaibinh province. The water concentrations gradually decrease towards the estuary and remain relatively consistent at various points within the estuary. The sediment concentrations are generally consistent with the pattern of DDT distribution where it is carried by the Red River downstream and then accumulated in the estuary as water slows (resulting in increased contact time between sediments and water). It is also consistent with accumulation of DDT in the sediments over time.

Most interesting is the comparison between sediment concentrations during dry and wet seasons - with a clear indication of leaching of DDT from the sediments during the rainy season. Other data collected since 1995 (not presented here) clearly show a trend of decreasing DDT concentrations in the water over time in the estuary, with somewhat stable concentrations in the sediments.

### Selangor river basin (Malaysia)

The Selangor river flows through predominantly agricultural areas on the eastern side of peninsular Malaysia, discharging to the Straits of

Malacca. The river is susceptible to EDC pollution as a result of runoff from agricultural areas. The sampling programme along the river was designed to initiate sampling in relatively pristine areas, collect samples in agricultural areas with high pesticide usage and culminate in the estuary in the Straits of Malacca.

The sampling was conducted during February and March 2000. The data for p,p'-DDT concentrations in the river water are shown in Table 2; with sampling points 1 through 4 representing pristine inland locations, and the remaining locations along the Selangor River downstream to the Straits of Malacca.

Table 2. p,p' - DDT concentrations (ng/mL) in river water samples (Selangor River)

Sampling point	Concentration	Comments
1	nd	Pristine areas
2	nd	
3	nd	
4	1.06	
5	29.04	River mouth
6	50.66	
7	25.00	
8	23.58	
9	44.77	

The data presented in Table 2 show a trend similar to that for the Red River - that is, a high concentration peak is observed at the suspect input point of agricultural runoff. This concentration gradually decreases downstream through loss to sediments and dilution.



Map of Malaysia showing Selangor river

# Modeling for Sustainable Development in the Lake Malawi/Nyasa International Basin of Africa

By Robert Hecky and Ralph Daley

All watersheds are “works in progress,” and all lakes are receptacles for the outputs of watersheds. These truisms take on special significance when the receiving lake has the most diverse fish fauna of any lake in the world and some of the contributing rivers have among the highest population densities in Africa.

Watersheds have always had to respond to natural perturbations, such as climate change, geologic activity and catastrophic meteorological events. Now, however, human settlement and population growth are the primary modifiers of watersheds around the world. The fate of the receiving lakes has clearly passed from the caprices of nature to the dictates of economic activities within the catchments.

The lake known as Lake Malawi in the country of Malawi, as Lake Nyasa in Tanzania and as Lake Niassa in Mozambique is no exception to this global trend. However, it faces a special risk not shared with other lakes. Lake Malawi has the most diverse fish fauna of any inland water body in the world – on the order of 1,000 species of fish, over 90 per cent of which are found nowhere else on earth. There are also numerous species of invertebrates that occur only in this lake.

This great biodiversity has astounded evolutionary biologists, as it dwarfs the more famous example of the finches in the Galapagos Islands (where a mere 14 endemic species were enough to stimulate Darwin to conceive the theory of natural selection). This high rate of endemism and extreme speciation, which makes the lake unique, led in 1986 to the establishment of the world’s first underwater freshwater park, recognized by UNESCO as a World Heritage Site. The preservation of the fauna and health of Lake Malawi, as well as the future of its riparian countries, are clearly a global concern. Recently, the expertise of the United Nations University International Network on Water, Environment and Health (UNU/INWEH) was asked by the World Bank to assist in the ecosystem management of this great African lake.

## Lake ecosystem development and current threats

The reasons for the origins of so many species in this African lake remain hotly debated by scientists. The taxonomy of the fish in the lake is itself a work in progress, with fewer than 300 of the species having been fully described. There are still several lifetimes of work by specialists before a complete catalogue of the species will be completed.

How so many species have managed to find and fill so many distinct ecological roles in this great lake ecosystem remains an even greater scientific mystery. Clearly time has been on the side of the fishes. Lake Malawi is among the oldest lakes on earth; its beginnings as a lake go back at least two million years, at which time large-scale tectonic plate movements began to rip apart the ancient African plateau. Large blocks of the earth’s crust subsided, and the spectacular mountainous landforms of the Rift Valley were created. Other ancient African lakes, such as Tanganyika and Albert, were also created along the western rift valley. Associated earth movements also led to the formation of the shallow Lake Victoria

basin.

Tanganyika and Victoria are the only lakes in the world that have developed similarly diverse faunas extending into modern times, although not in the same spectacular manner as Malawi. Of all the ancient African lakes, Malawi is unique in its degree of evolutionary radiation in the cichlid fishes, which are broadly distributed throughout the tropics and subtropics. The immense size of the African lakes and the great depths of Tanganyika (over 1,400 meters deep) and Malawi (over 700 meters deep) also provided spatial diversity, allowing adaptation into various physical and biological regimes.

Until recently, it was thought – and, more latterly, hoped – that the gargantuan size of the lakes would protect them from degradation and, therefore, protect the endemic fauna from ecological stress and possible extinction. However, this hope was destroyed as water quality degradation and exotic species has led to massive species loss in Lake Victoria over the past 30 years, just as it had with great lakes in Europe and North America.

International concern about the future of Lake Malawi and its fauna was expressed when the Global Environmental Fund (GEF) joined with the riparian nations, all of which are members of the Southern African Development Community (SADC), to implement the SADC/GEF Lake Malawi/Nyasa Biodiversity Conservation Project. This programme, which ran from 1996–2000, accelerated study of the lake’s fish biodiversity and ecology and, for the first time, examined the water quality of the lake and its rivers in a systematic fashion.

Since the end of the nineteenth century, human activities have increasingly altered natural landscapes around Lake Malawi. Humans are not new to the ecology of Lake Malawi, as the evolution of the fishes was contemporaneous with that of humans. However, population densities 10 times higher than prehistoric levels are unprecedented. In addition, those populations are much more sedentary than in the past, when local overuse of resources would lead to population migrations. Today, fixed international boundaries and population growth everywhere in southern Africa generally prevent long-distance migration. Within Malawi, however, there is a current wave of agricultural settlement moving from the southern portions of the country into the more mountainous northern portions of the Lake Malawi basin. With population pressures becoming so extreme, mountainous regions are increasingly coming under cultivation, especially along the rift escarpment that bounds the lake.

## Modeling to predict the future state of the lake

The SADC/GEF project was the first to document the effects of settlement patterns and agricultural activity on river water quality. Those studies showed that loss of forest and bush cover led to increased water runoff, more erratic river discharges, increased erosion and increased loss of nutrients into the rivers. From the lake’s perspective, this has meant increased water levels, increased sediment loading and increasing nutrient concentrations. Such changes are known to have caused the degradation of Lake Victoria, with the

accompanying degradation of local potable water and increased risk of water-borne disease.

But what are the consequences of these watershed changes to the water quality, fisheries and biodiversity of Lake Malawi, and to the future development of its catchment? To answer these questions, and to determine whether watershed management can ameliorate such changes, a new approach is required. Only environmental modeling based on relevant experience from around the world can provide these answers. Therefore, the World Bank engaged UNU/INWEH to prepare a “Physical Processes Model for Lake Malawi” using the database created by the SADC/GEF project. The goal was to successfully model the current state of the system and make projections into the future. To develop the required models, UNU/INWEH joined forces with Delft Hydraulics of the Netherlands and the University of Waterloo in Canada.

The rationale for a modeling approach is clear: Species extinctions are not reversible phenomena. Thus, it is imperative that environmental management be proactive, not reactive, and that scientific information be put to work, through modeling, to enable resource managers, political decision makers and the public at large to foresee the future consequences of their actions.

On a practical level, modeling to predict the future state of the Lake Malawi ecosystem is necessary for several other reasons:

- ecosystem changes take place slowly over many years;
- long-term observational records to detect change are not available in most of Africa;
- delaying action (until conclusive proof of environmental degradation and species loss in such a large lake is available) would make corrective action prohibitively expensive, perhaps impossible.

Faced with these realities, the primary goal of the World Bank and UNU/INWEH was to apply ecosystem modeling to guide future development of the Lake Malawi basin and to ensure that development programs would not degrade the sustainability of this critical and unique aquatic resource. A second important purpose of the project was to explore the applicability of existing generic models as the most cost-effective way to introduce ecosystem modeling to national management agencies in the riparian countries. Workshops to train national resource persons from the three countries and to demonstrate the utility of the models to decision makers were a critical part of the initiative.

To apply the best generic models available worldwide, UNU/INWEH approached Delft Hydraulics to contribute its three-dimensional hydrodynamic model, the National Water Research Institute of Canada to adapt its Lake Erie Water Quality Model, and the University of Waterloo to adapt an Agricultural Non-Point Source Watershed Model originally developed by the US Department of Agriculture. These models were interconnected through the “RAISON” software, an environmental decision-support tool developed by Environment Canada, which was linked to a Public User Interface contributed by the University of Guelph. UNU/INWEH provided overall project leadership and management through Dr. R.E. Hecky, UNU Chair for African Great Lakes at the University of Waterloo.

Despite the complexities inherent in coordinating multiple

modeling teams operating on two different continents, a well-integrated, effective set of models was developed. The models’ performance exceeded expectations, given that generic models were being adapted beyond their original calibration data sets. The watershed model predicted water discharges and sediment loads in the rivers acceptably well, and river nutrient concentrations remarkably well, under a wide range of meteorological conditions. The hydrodynamic model produced the seasonal dynamics in lake water-column structure quite well, and provided the structural boundaries for an 11-box water quality model that accurately predicted concentrations of the critical nutrients phosphorus and nitrogen in the various parts of the lake.

The model, in its most promising application, also accurately predicted which portions of the river catchments were producing the most erosion and nutrient loss. This is important since it is these areas that pose the greatest risk to the lake as well as impoverishing the land resource. It was also possible to simulate in the model how reforestation of the catchment would lead to improvements in river and lake water quality. Fifty per cent reforestation of one river basin was predicted to lead to a 40 per cent reduction in phosphorus concentrations in the shallow, most eutrophic southern basin of the lake, where Lake Malawi National Park is situated. Conversely, continued loss of forest was shown to cause further nutrient enrichment, water quality degradation and loss of fish habitat for the park area and the lake as a whole.

Natural resource agencies in the three riparian countries have been quick to recognize the model as both a powerful planning tool and an effective communication vehicle to demonstrate the results that can be obtained through informed environmental management. Malawi and the World Bank are adopting the model as they initiate planning for a new project intended to further strengthen national agencies to manage the natural resources of Lake Malawi effectively. The goal and challenge is sustainable development of the region’s resources for the maximum benefit of the eight million people who live in the Lake Malawi basin, while protecting one of the world’s unique and irreplaceable biodiversity heritages. W



# International River Basin Management

By Mikiyasu Nakayama and Libor Jansky

The activities undertaken by the United Nations University cover a broad range of issues related to the water, life and the environment. The International River Basin Management initiative, in general, focuses on seriously threatened water bodies and on the most pressing transboundary threats to their ecosystems. The initiative is a follow-up to the 2nd World Water Forum and the Ministerial Conference in The Hague (March 2000) where a UNU delegation, represented by Rector Hans van Ginkel, supported the Ministerial Declaration on Water Security in the 21st Century.

## Key tasks

Among the key tasks to be accomplished are changes of sectoral policies and activities to solve the top-priority transboundary environmental concerns, thereby promoting and improving sustainable water management and protecting the environment, aquatic life and ecological balance of the international river ecosystem. Initiatives to solve transboundary water issues will focus on basins of the world's five developing regions: Sub-Saharan Africa, Asia, Latin America and the Caribbean, Middle East/North Africa, and Eastern Europe/former Soviet Union. UNU will identify and disseminate innovative examples and models that have potential for replication. (Some international agencies, for example, are considering the framework and database developed by the latest internationally funded River Danube project as a potential model for reporting on other international waters projects.)

Identifying strategies for management of transboundary water resources within selected international river basins will be based on the findings of on-going workshops of decision makers, high-level bureaucrats and multidisciplinary groups of scientists. This project forms a part of the UNU's follow-up to Chapter 18 of Agenda 21, "Protection of the Quality and Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management and Use of Water Resources."

An extensive discussion with experts in the field of water management was initiated in May 2000 to obtain a broader understanding of the topics under this project and shape UNU's contribution in the field of international river basin management in the coming years. As the activities are frequently linked with political issues involving several riparian countries, the project will further relate to the priority areas of environmental governance and transboundary environmental issues in one or two freshwater basin projects. It also may be linked with one large marine ecosystem project, which would fit into the larger picture of UNU activities in the area. A proposal for the synthesis of past findings and lessons will be elaborated and further discussed in the expert group and will serve for future orientation of a comparative study that concentrates on selected freshwater basins.

Because international river basin management activities are frequently linked with political issues involving several riparian countries, the project would further relate to the priority areas of research of UNU's Peace and Governance Programme – particularly, environmental governance. As other UNU institutions, notably the International Network on Water, Environment and Health (UNU/INWEH) and Institute for Natural Resources in Africa (UNU/INRA), have considerable expertise in this area, the new

project also could become an effective vehicle for promoting cross-programme cooperation. The uniqueness of the UNU approach in this international water project could, therefore, be in combining transboundary environmental and environmental governance issues that would fit into the larger picture of the UNU portfolio.

During the past few years, UNU work has addressed several transboundary issues. Perhaps most interesting of these is Ganges-Bramaputra-Meghna River Basin; in 1999, UNU organized a Ganges-Bramaputra forum as a neutral platform for cooperation by Bangladesh, India and Nepal. Three country studies undertaken in 1999 (with support of the Government of the Netherlands) highlighted a number of win-win options and collaborative scenarios. Prospective areas of cooperation include energy, flood and flow management, and water quality.

## Workshop on Southern African Waters

Some parts in the southern African region have been suffering from a paucity of water for years, a trend that has been worsened by the rapidly increasing population of the region. (Population growth in some countries is as high as 3.5 per cent per year; sustained growth at that rate would lead to a doubling of the population in two decades.)

Numerous transboundary water transfer schemes have been proposed to alleviate the problem in the southern African region. Some plans that are under discussion among nations of the region, however, may create other sorts of problems. For example, the Lesotho Highland Water Project between Lesotho and South Africa, one of the largest transboundary water transfer schemes, is a matter of dispute in an environment-versus-development context, with involuntary resettlement being a particular issue. The proposed water transfer scheme from Botswana to Namibia, meanwhile, has been controversial in the same context from the viewpoint of the possible impacts on wetland systems of the Okavango Delta.

In September 2000, the UNU organized a Workshop on Southern African Waters (in Sandton, South Africa) to focus on sustainable development of international river systems in the southern African region. The southern African region needs to develop solid and functioning frameworks for collaboration among nations, both for individual water systems as well as for the region as a whole. The important questions to be answered are: "To what extent can such new frameworks go under existing mechanisms?" and "What needs to be done, in terms of institutional and legal frameworks, to go beyond the present 'limit'?" Only by developing new collaborative frameworks will nations of the region be able to utilize their shared water resources in a more rational and efficient manner.

The United Nations has been instrumental in this connection. For example, the United Nations Environment Programme (UNEP) in the 1980s assisted the basin countries of the Zambezi River Basin, resulting in adoption of the Zambezi Action Plan (ZACPLAN) in 1987. The ZACPLAN is still regarded by the riparian states as a fundamental framework for collaboration, despite the fact that it was established under different political regimes in the region (particularly of South Africa) and that some of its contents may now be obsolete.

It is very timely that the UNU sees this issue from an academic viewpoint. The UNU has organized or helped others to organize workshops on international waters in various parts of the world, and



The Danube River basin covers 17 countries in Europe which includes many important ecosystems of high environmental value such as wetlands and floodplain forests. (Photo: Libor Jansky, UNU)

thus is in the position of making best use of the findings attained through these previous workshops, conferences and meetings. The UNU could serve as the academic focal point within the United Nations system for the sake of developing a synthesis of these findings, which would be useful not only for South Africa but also for other regions of the world.

The aim of the Workshop on Southern African Waters, therefore, was to consider the following questions:

- What will take place in the foreseeable future within the region because of a paucity of water resources in the event that there is no significant change in the way nations cooperate for the sake of their shared water resources?
- What kind of advancements may realistically be achieved in the sharing of water resources if the nations of the region would have a better collaborative framework than they have today?
- What must be done to materialize such a change by improving the way riparian states collaborate?

Efforts were also made by the workshop to ensure that the wisdom in important thematic issues (e.g., the power of information disclosure and public participation towards achieving better collaboration among riparian states, the legal framework required among basin countries, and the institutional settings needed to ensure mutual trust among nations) would be elaborated for application to southern Africa and other parts of the world.

Thirteen participants, about half from the southern African region

and the rest from other parts of the world, attended the workshop to present their viewpoints about the relevant issues. The issues were discussed both from the above-mentioned thematic viewpoints and through analyses of cases in the region, such as the Orange, Zambezi, Limpopo and Kunene river basins.

The need was urged for greater participation from individuals and non-governmental organizations in managing the region's water resources. It was argued that by involving the public and local experts, the region could devise more effective and resilient water agreements. The Southern African Development Community (SADC) was analysed in terms of its ability to promote effective basin-level management institutions. Two presentations were made about analytical tools for water resources management, namely the Transboundary Freshwater Dispute Database (TFDD) and the Decision Support Systems (DSS) designed for the managers of the Lake Kariba hydropower scheme. In terms of cooperative water management, the participants identified various forms of current and planned collaborative efforts in the region including formal, informal, bilateral and multilateral relationships.

Papers based on presentations and discussions at the workshop are scheduled to be published in a volume by the UNU Press in late 2001. This book will serve as a precursor for further development of the southern African region on the issue of promoting collaboration among states towards better management of international water systems.

# An Update on the UNU Geothermal Training Programme

By Ingvar B. Fridleifsson

The aim of the UNU Geothermal Training Programme (UNU/GTP) is to assist developing countries with significant geothermal potential to build up or strengthen groups of specialists in most aspects of geothermal exploration and development. This is done by offering a six-month session of specialized courses for professionals who have practical experience in geothermal work in their home countries.

The UNU/GTP is operated at Orkustofnun, the National Energy Authority (NEA) of Iceland, which has been an Associated Institution of the UNU since 1979. Since the foundation of the UNU/GTP in 1979, 245 scientists and engineers (211 men, 34 women) from 36 countries have completed the full six-month programme of courses.<sup>1</sup> Of these, 44 per cent have come from countries in Asia, 26 per cent from Africa, 15 per cent from Latin America, and 15 per cent from Central and Eastern Europe.

The 22nd annual session of UNU/GTP was held from 8 May through 27 October 2000. Eighteen Fellows<sup>2</sup> (14 men, 4 women) from 10 countries participated: five from China, three from Poland, two



Fellows of the 22nd annual course of the UNU Geothermal Training Programme in 2000 (Photo: Ludvik S. Georgsson, UNU/GTP)

each from Kenya and Ukraine, and one each from Costa Rica, El Salvador, Iran, Russia, Tunisia and Uganda. Seventeen attended on fellowships from UNU and the Icelandic Government, and one on a fellowship from the International Atomic Energy Agency (IAEA).

The main emphasis of UNU/GTP training is to provide participants with sufficient understanding and practical experience to independently execute projects within their selected discipline in their home countries. The curriculum of the programme, which includes nine specialized lines of training, can be seen on the UNU/GTP homepage.<sup>3</sup> Among this year's Fellows, seven received specialized training in reservoir engineering, three in the chemistry of thermal fluids, two in drilling technology, two in environmental studies, and one each in borehole geology, geological exploration, geophysical exploration, and geothermal utilization.

The UNU Fellows spend about half of their six-month stay in Iceland working on research projects. Some bring data for their research from their home countries while others participate in ongoing projects at NEA or other agencies. The project reports are published in the annual yearbook of the UNU/GTP, which is distributed to former UNU Fellows as well as universities and leading geothermal research and development institutions in more than 40 countries. In 2000, 11 of the research project reports dealt with geothermal areas in the Fellows' home countries, 2 dealt with geothermal fields in Iceland, 3 covered theoretical issues, and 2 were comparative studies of geothermal activity in Iceland and the Fellow's home country.

The UNU/GTP has three permanent staff; lecturers and support staff come from Orkustofnun, the University of Iceland and other agencies/companies. Most of the teaching and supervision duties for 2000 was handled by geothermal specialists of Orkustofnun (70 per cent) and the University of Iceland (20 per cent). The UNU Visiting Lecturer 2000 was Dr. Trevor Hunt, geophysicist from the Institute of Geological and Nuclear Sciences in New Zealand and member of the Board of Directors of the International Geothermal Association, who gave a series of lectures on the environmental aspects of geothermal utilization.

## World Geothermal Congress 2000 in Japan

The World Geothermal Congress is convened by the International Geothermal Association every five years. World Geothermal Congress 2000, held in Japan 28 May through 10 June, was attended by more than 1,250 participants from 61 countries.

The proceedings of the congress, which have been published on CD-ROM, include 670 technical papers presented in lectures and poster sessions. Of these, 88 papers were authored or co-authored by former UNU/GTP Fellows, many of whom presented the country papers for their respective countries (and who were, in some cases, the only representative of their country). The Fellows made a very significant contribution to the congress, and their participation has certainly strengthened the position of their respective institutions/countries in international geothermal cooperation.

The UNU/GTP was heavily involved in the preparations for the congress. The director of the UNU/GTP, Dr. Ingvar B. Fridleifsson, who served as President of the International Geothermal Association from 1995 through 1998, convened a plenary session on the opening day of the congress and delivered three papers at other sessions. The UNU/GTP deputy director and several UNU/GTP teachers/instructors also presented papers and served as session chairmen. UNU Rector Han van Ginkel addressed the congress at a plenary session on international co-operation and gave an overview of the activities of the UNU worldwide.

A reunion of UNU Fellows gave old and young Fellows an opportunity to meet. Some, who trained in Iceland as much as 20 years ago, are now leaders of geothermal development in their respective countries.

1 More than 70 others have participated in shorter training sessions.  
2 In addition, one engineer (from Jordan) was working on an M.S. degree at the University of Iceland under a special agreement between the university and UNU/GTP, and a staff member of the International Red Cross (a Tunisian engineer) participated in the five-week introductory lecture course.

3 <http://www.os.is/unugtp/>

# Zero Emissions Forum

By Motoyuki Suzuki

*“Achieving the goals of environmental quality and sustainable development will require efficiency in production and changes in consumption patterns in order to emphasize optimization of resource use and minimization of waste. In many instances, this will require reorientation of existing production and consumption patterns that have developed in industrial societies and are in turn emulated in much of the world.”*

Agenda 21, Chapter 4 (1992)

In 1994, the United Nations University launched an ambitious new research initiative designed to investigate various approaches and technological breakthroughs requisite to the creation of a new type of industrial system. Under this initiative, the reduction of potentially adverse emissions to zero is promoted as an effective means to uncouple the links between economic growth/material consumption and ever-increasing resource utilization, waste and environmental damage. This transformation of contemporary patterns of industrialization to more sustainable forms requires a new perspective as embodied in the UNU Zero Emissions approach.

Since 1999, UNU has adopted a facilitating role in fostering Zero Emissions-related activities through the UNU/Zero Emissions Forum (ZEF). This forum brings together representatives from business, government and the scientific community in pursuit of three objectives:

- **Research** – ZEF promotes international multidisciplinary research efforts to analyse trends in society and technology using a range of methodologies;
- **Capacity Building** – Working closely with leading universities, ZEF is promoting the development of multidisciplinary centres of excellence in Zero Emissions; and
- **Networking** – ZEF is collaborating with development institutions, funding agencies, governments, businesses and communities to stimulate regional and local Zero Emissions initiatives across industrial and social sectors worldwide.

## The Zero Emissions concept

The Zero Emissions concept is based on the full and effective utilization of the earth’s limited resources and the minimization of human impacts on the natural environment. Construction of environmentally sound material cycles is one of the key approaches to guaranteeing not only the minimization of wastes but also increases in revenues based on innovative and productive ideas.

Zero Emissions represents a shift from the traditional industrial model in which wastes are considered the norm, to integrated systems in which everything has its use. It advocates an industrial transformation whereby businesses emulate the sustainable cycles found in nature, and where society minimizes the load it imposes on the natural resource base and learns to do more with what the earth produces.

The Zero Emissions concept envisages all industrial inputs being used in final products or converted into value-added inputs for other industries or processes. In this way, industries are reorganized into clusters, such that each industry’s wastes/by-products are fully matched with the input requirements of another industry, and the integrated whole produces no waste of any kind. For businesses, Zero

Emissions can mean greater competitiveness and represents a continuation of the inevitable drive towards efficiency.

Zero Emissions also promotes a shift in society as a whole. It is widely recognized that production and consumption are tightly intertwined activities. Achieving Zero Emissions at a societal level includes addressing such issues as urban and regional planning, consumption patterns, energy conservation, upstream industrial clustering, the reuse and recycling of products, and the interactions of these activities with the local industrial production base.

The ZEF approach involves bringing together two main research areas. The first involves the analysis of product cycles, while the second examines the evolution of these cycles and their impacts on society. This is being promoted through the activities of three ZEF networks composed of representatives from business, academia and local communities.

## Zero Emissions for industry

For business participants in ZEF, the fundamental issue is how to organize industrial clusters based on the Zero Emissions concept. In this context, case studies and demonstration projects are being developed to show how the Zero Emissions approach differs from other pollution-prevention strategies. Businesses need to maximize resource productivity at the firm/inter-firm level rather than simply minimizing the wastes or pollution associated with a given product. Under the Zero Emissions approach, long-term sustainability depends on massive reductions in waste and pollution, but ensures that such reduction and dematerialization are economically favourable.

## Zero Emissions and scientific research

ZEF is currently strengthening on-going scientific research efforts in the area of natural resource development in order to increase utilization efficiency and to replace the current reliance on fossil fuels. Key research areas include integrated biosystems, materials separation and biorefinery.

## Zero Emissions and local communities

The Zero Emissions Forum, in close collaboration with local governments, addresses the challenge of creating sustainable communities. In this context, UNU has begun to encourage local governments in Japan to work with their communities to develop Zero Emissions strategies and to include Zero Emission concepts in their environmental plans and projects. Local business and “green” consumer group are encouraged to network and create waste inventories.

## Implementation of the ZEF approach

Since the launch of the Zero Emissions initiative by UNU in 1994, numerous international events have been organized. These include four World Congresses – in Tokyo (1995), Chattanooga (1996), Jakarta (1997) and Windhoek, Namibia (1998) – where government, industrial and agricultural Zero Emissions activities have been reported and discussed. In addition, annual conferences of the Japan Zero Emissions Network (JZEN) have been organized since 1996. These events have created considerable interest in and support for the Zero Emissions concept, both internationally and in Japan. Building

## Focusing on the Real Environmental Culprits – Urban Areas: UNU's City Inspirations Initiative

By Hari Srinivas

The criticality of urban environments is highlighted by the fact that most of today's global environmental problems can find their precedents and causes, directly or indirectly, in urban areas (which have become the preferred choice of settlement for a majority of humanity) and urban lifestyles. Urban centres have far-reaching and long-term effects, not only on their immediate boundaries but on the entire surrounding region.

Along with the benefits of urbanization and agglomeration come a variety of environmental and social ills, including lack of access to safe drinking water and sanitation, carbon emissions and other air pollutants, etc. And while cities and urban areas are directly or indirectly causing global environmental problems, they are also, in turn, being affected by them. Clearly, there are cyclical links between urban areas, lifestyles and consumption patterns on one hand, and global environmental problems on the other.

### Tokyo's footprint analysis

The relevant scenarios are aptly illustrated by "footprint analyses" of cities. The "footprint" of a city is the amount of land required to sustain its metabolism – that is, to provide the raw materials on which it feeds and process the waste products it excretes.

We can look at Greater Tokyo as an example. The metropolitan area's population in 1995 was 26.6 million, out of a total nationwide population of 125.1 million. The total land area of Japan, meanwhile, is 377,700 sq km (37.77 million hectares), of which only about 33 per cent (125,500 sq km, or 12.55 million hectares) is habitable.

According to an Earth Council report,<sup>1</sup> a biologically productive

1 *Ranking the Ecological Impact of Nations* (San Jose, Costa Rica: The Earth Council, 1997).

area of 1.7 hectares per person is required for basic living. This means that sustaining the people living in Tokyo alone requires an area of 45.22 million hectares – which is 1.2 times the total land area (and 3.6 times the habitable area) of Japan.

Based on statistics from the same report, Japan as a whole has a demand of 6.25 hectares per capita (for resources such as energy, arable land, pasture, forest, built-up areas, etc.). The supply, however, has been only 1.88 hectares per person, leaving an "ecological deficit" of 4.37 hectares per person that has to be met from outside the country. For Tokyo alone, the ecological deficit is 116.24 million hectares, or more than three times the total land area of Japan.

Looking at this from another viewpoint, the area required for food production is 0.20 hectare per person. For Tokyo's population, that is a total of 5.32 million hectares (1). Similarly, the area required by Tokyo's population for wood and other products is 0.11 hectare per person, or 2.90 million hectares (2), while the land area required for carbon sequestration (cleansing) is 1.5 hectares per person, or 74.21 million hectares (3.) The total of (1), (2) and (3) is 108.53 million hectares, which is about 2.14 times the land area of the whole of Japan.

While the above methodologies give different multiples of Japan's land area needed to sustain the population of Tokyo (footprint analysis is not an exact science), this does help us to understand the magnitude of the dependence of cities on outside resources, and the effects/impacts of urban living patterns.

### An urban environmental management framework

The myriad upstream and downstream impacts of cities and the resulting challenges call for an effective response, one that takes place

## Zero Emissions Forum *(Continued from page 24)*

upon this experience, ZEF will hold regular conferences and seminars in order to more effectively disseminate the findings of on-going Zero Emissions related research activities.

Zero Emissions research at UNU is augmented via collaborations with universities and research institutes around the world, including in Brazil, China, Germany, India, Indonesia, Japan, Latvia, Namibia, Nigeria and Sweden. Zero Emissions research is also being pursued independently by many institutions engaged in promoting the paradigm shift towards a sustainable society.

UNU works with governments and industry to launch research programmes and pilot projects designed to demonstrate not only the technical viability, but also the economic advantages of Zero Emissions approaches. UNU is encouraging communities to work together at the local, regional and state levels to share their experiences on Zero Emissions and discuss strategies for achieving global Zero Emissions. UNU is also promoting cooperation between government, industry, and communities to make a concerted effort towards the realization of a sustainable society.

In addition, technological approaches to the achievement of sustainable development in industrial production are currently being undertaken by a number of UN agencies, including UNIDO, UNDP, FAO and UNEP.

A key area of activity relates to national capacity building through training and education, workshops, conferences, information dissemination and networking. Training course curricula and materials will be designed in collaboration with key institutions and tailored to different target groups (e.g., trainers, scientists, the private sector, policy makers, etc.).

The UNU Zero Emissions Forum maintains contacts and collects information on the various independent initiatives on Zero Emissions. At the same time, ZEF disseminates information on research through publications, education, training courses and conferences. Through the Zero Emissions Forum, UNU will continue to bring together international representatives from academia, business, and governmental and non-governmental organizations to promote the continuing evolution of the Zero Emissions concept.

within a coherent framework for policy and action, where urban problems can be identified and tackled. Such an urban environmental framework would have a three-fold objective:

- (a) to develop awareness and educate on issues related to urban environments;
- (b) to assist in policy and programme development; and
- (c) to facilitate monitoring and evaluation.

The target audience of this framework includes urban government agencies, NGOs, donor agencies, community groups and other urban stakeholders.<sup>2</sup> Among the key issues to be addressed by this framework are the following:

*Urban environments pose a challenge for effective distribution and management of global resources.* The density and population of modern urban areas necessitates an equitable distribution of necessary resources. And because of the large amount of resources needed to sustain a city, this, in turn, requires an understanding of the effects of an urban area both within its immediate boundaries and within the region and country. At the same time, we must remember that an urban area generates a GDP far in excess of its share of population.

*There is need for a balance between natural and built environments, and between ecological and economic objectives.* The agglomeration and centrality of resources and skills that an urban area offers should be balanced with the natural environment and natural resources (air, water, land and minerals). The economic objectives of job creation, income generation and distribution, particularly for developing countries, will have to be tempered with ecological objectives of sustainable living. The priority that developing cities place on economic development and income distribution over environmental issues has to be understood from the larger perspective of long-term human development. (More than 41 per cent of Thailand's GDP is generated in Bangkok and other major cities, for example, but at a huge environmental cost.)

*Identification of the actions that are necessary will require development of a structure of goals/visions, and a methodology to achieve it.* This structure of goals and visions for sustainable urban living should be understood by ordinary citizens. This will allow communities and governments to discuss how goals can be achieved at a tangible level of the community or household. Goals and visions will also attribute legitimacy and currency to the problems faced in urban environments and set the platform on which these problems can be addressed by taking appropriate action at the appropriate level.

*While directed at long-term goals, the steps must be relevant in the short-term to gain wider acceptability.* To ensure that the issues are properly understood and tangible/visible results are achieved, the goals and visions should be classified as immediate, intermediate or eventual. This will also ensure stronger long-term participation from all stakeholders. Sharing and cooperation on essential lessons, practices and technologies is critical.

*Access, sharing and dissemination of information must be prioritized to achieve greater understanding of the issues involved.* The cause-and-effect reasoning of local action has to be understood

from a regional and global perspective. The key to achieving this understanding and exploration is easy, adequate and immediate access to information. Timely and packaged information is key to influencing the local decision-making processes that, on a cumulative basis, have global repercussions. The use of appropriate communication and information technologies should be encouraged.

*Collaborative city-to-city efforts in "knowledge transfer" have to be encouraged, particularly between developed and developing cities.* This involves collaboration by institutions and governments in developed and developing countries for the transfer of urban "software": best practices, innovative technologies, practical solutions, and effective regulations and legislation. This can cover, among other issues, policies, programmes, skills, and local and city governance.

*The concept of sustainable development and sustainable living (in all its varied definitions) must be understood and implemented.* Wider participation to achieve the goals of sustainable development and living must be encouraged; sustainable living should become a way of life rather than a concept espoused by an enlightened few. This will involve the community, local government, and the whole range of non-governmental organizations (including the private sector) in developing environmental consciousness, education and training, capacity building, and environmental governance.

*The development of new technologies that are clean, green, and practical should be encouraged and exchanged between national and city/local governments to address local environmental problems.* The environmental consequences of current technologies have to be assessed, while the transfer of environmental technologies has to be enabled through a variety of governmental and non-governmental forums (including online networks). Collaboration among universities and research think tanks has to be enabled so that appropriate technologies are quickly developed and disseminated.

While the contents of the urban environmental management framework provides a broad vision, its applicability lies in establishing policies, programmes and projects that operationalize the objectives in the long term, and set up mechanisms to monitor and evaluate them at every stage.

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## The justification for UNU's City Inspirations Initiative

Environmental management is a global phenomenon, embracing different stakeholders, whether or not environmental impacts are managed in an organized manner. Today, there are inequalities between high-income and low-income nations in terms of income distribution, consumption patterns, access to urban services and resources, and environmental impacts. Yet governments and non-governmental entities are committed, through a variety of legislation, conventions and agreements, to achieving a better managed environment.

Particularly in Japan, public awareness of environmental issues has been rising in recent years, and degradation of the environment has been subject to stringent regulatory legislation, voluntary action, and increasing consumer and stakeholder pressure on local governments, business and industry to adopt a "green" face. Underlying the internal and external changes that Japan is undergoing

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<sup>2</sup> For more about the framework, see Hari Srinivas, "Urban Environmental Management: A Partnership Continuum," in Inoguchi et al. (eds.), *Cities and the Environment* (1999; Tokyo: United Nations University Press, pp. 30–46).



in the social, economic and ecological fronts has been a key common denominator – the local environment. Numerous issues have been brought under the umbrella of a sustainable environment, seeking justifications, priorities and solutions that aim at an environmental and ecological balance. This has touched almost every sphere, particularly in bringing the role of local government to the fore and its ability to forge partnerships with a range of urban stakeholders. Prioritizing the environment at all levels of governance has been a result of both learning from the mistakes of the past (such as the Minamata disease or the industrial pollution of Kita-Kyushu) as well as looking to the future (such as the Kyoto Protocol).

It is against this background that the City Inspirations Initiative was launched at the United Nations University, in June 2000, to document and disseminate best practices in environmental management at the local level in Japan. It was initiated to enable cities and local governments in the developing countries of the Asia-Pacific region to gain from the experience of Japanese cities – not only in finding innovative local solutions, but also in avoiding the repetition of past mistakes.

The first phase of the Initiative (2000–2001) focuses on Japanese cities, while the next phase will include cities in other regions. The complexity of local environmental management in Japanese cities has clearly raised the need for a better understanding of the different strengths, potentials and roles of local stakeholders. It has also emphasized the importance of local urban governments in these processes. Concepts such as local autonomy, information disclosure, informed choice, decision-making models, etc. have been increasingly used in local planning and development. Using lessons learned from the Japanese experience, developing cities in the Asia-Pacific region will need to place greater emphasis on the role of local governments in environmental management while simultaneously calling for wider and deeper participation and partnerships with all local urban stakeholders.

The objectives of the Initiative are to:

- (a) understand the networking and partnership processes between local governments and other urban stakeholders, and to highlight the critical (direct and facilitative) role of local governments in these processes;
- (b) document, in an easily understandable and adaptable format, local environmental management initiatives at the local level in Japan in order to be able to transfer them to developing cities; and
- (c) provide a menu of options in environmental management practices for developing cities of the Asia-Pacific region.

Information is collated via a variety of means, including direct contact with local government officials in Japan and through brochures, pamphlets, reports and other secondary material from a variety of sources. The collected information is studied and analyzed to extract “City Inspirations” that can be summarized and condensed.

The objective of an “Inspiration” is simply to inspire. It does not provide detailed technical or policy guidelines, but simply a menu of different ways of tackling environmental problems. By outlining the various tools used, stakeholders partnered with and projects implemented, an “Inspiration” enhances its transferability.

A “City Inspiration” includes the numerous aspects, including the initiator of the inspiration, essential elements and aims, partners sought and the processes of partnership, processes of implementation, unique features and ingredients of success/failure, lessons learned, and contact persons/institutions for further information. To enhance replicability and ensure ease of understanding, each inspiration is presented on a single sheet of paper, including contact addresses for additional information. Photos and graphical means of presenting information are used to enhance understanding of the inspiration.

The collection of inspirations will be presented in a loose-leaf folder and also made available via a website.<sup>3</sup> The print version contains contact addresses for further information while the online version provides links to relevant additional information.



3 See <http://www.unu.edu/env/c%2Dinsp/index.htm>

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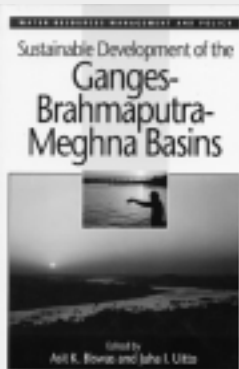
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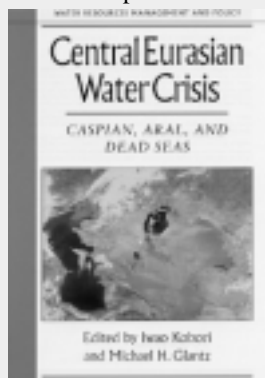
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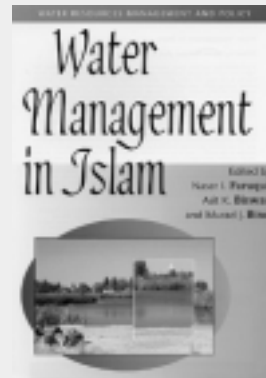
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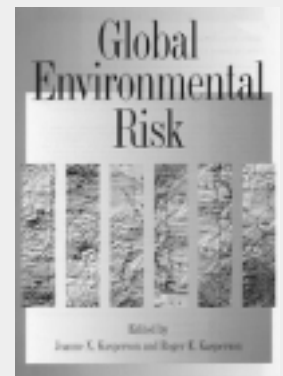
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