

The Third Biennial Meeting of  
The International Society for Ecological Economics

# DOWN TO EARTH

*Practical Applications of Ecological Economics*



Final Program and Abstracts

*October 24-28, 1994 - San Jose, Costa Rica*



**ISEE**

International Society for  
Ecological Economics



UNIVERSIDAD NACIONAL

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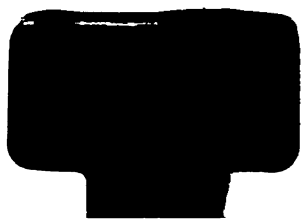
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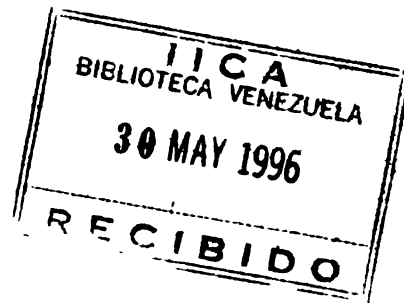


RECIBIDA

The Third Biennial Meeting of  
The International Society for Ecological Economics

# DOWN TO EARTH

*Practical Applications of Ecological Economics*



## Final Program and Abstracts

Working document prepared by  
Daniel Vartanián (IICA)  
Ana Cecilia Pérez (UNA)

*October 24 -28, 1994 – San Jose, Costa Rica*



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San Jose, Costa Rica  
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# Presentation

*The Inter-American Institute for Cooperation on Agriculture (IICA) and the Universidad Nacional of Costa Rica (UNA) are pleased to present this document, which contains the program for and abstracts of papers to be presented at the Third Biennial Meeting of the International Society for Ecological Economics, organized by the International Society for Ecological Economics (ISEE) and the Universidad Nacional of Costa Rica.*

*The principal topics of the conference reflect the interests of the ISEE, as defined in previous international meetings and, especially, in activities carried out since the Second International Conference to discuss key issues in the field of ecological economics, taking a realistic approach to conditions, experiences and practical advances, as well as the academic contributions that are needed, and can be made, to build sustainable processes of economic and social development.*

*On this occasion, the conference is being held in a country of the developing world and in the tropical region of the Americas, with a view to establishing closer ties with one of the richest sources of biodiversity, in which there is growing interest. Social conditions in the developing world, characterized by an inadequate food supply and a generalized lack of well-being, also provide an appropriate framework for the conference and should be taken into account when considering humanity and its surroundings as a whole.*

*This Third Meeting of the ISEE, which is entitled Down to Earth: Practical Applications of Ecological Economics, focuses on seven key topics, which will be discussed in plenary sessions, as well as sub-topics included in each, which will be examined in greater detail in workshops. Both the plenary sessions and the workshops will be conducted by speakers and thinkers of the highest caliber, all of whom are interested in making an effective contribution.*

*This document will provide participants with information on the location of the different working sessions, as well as the principle ideas the speakers put forth in the abstracts submitted to the organizers of the conference. Given the diversity of approaches, attributable many times to the different realities observed around the world, it was at times difficult to include in the technical sessions or display area all the papers submitted. However, this document makes it possible to locate speakers and the respective sessions, allowing participants to select those presentations most related to their field of endeavor.*

*Given the preliminary nature of many of the ideas, as well as the specific nature of this document, it should not be assumed that the ideas expressed in the abstracts contained herein are the final positions of the authors on the topics being addressed. Likewise, the ideas expressed in same are those of the authors and do not necessarily reflect the views of the institutions where the authors work or the countries they represent.*

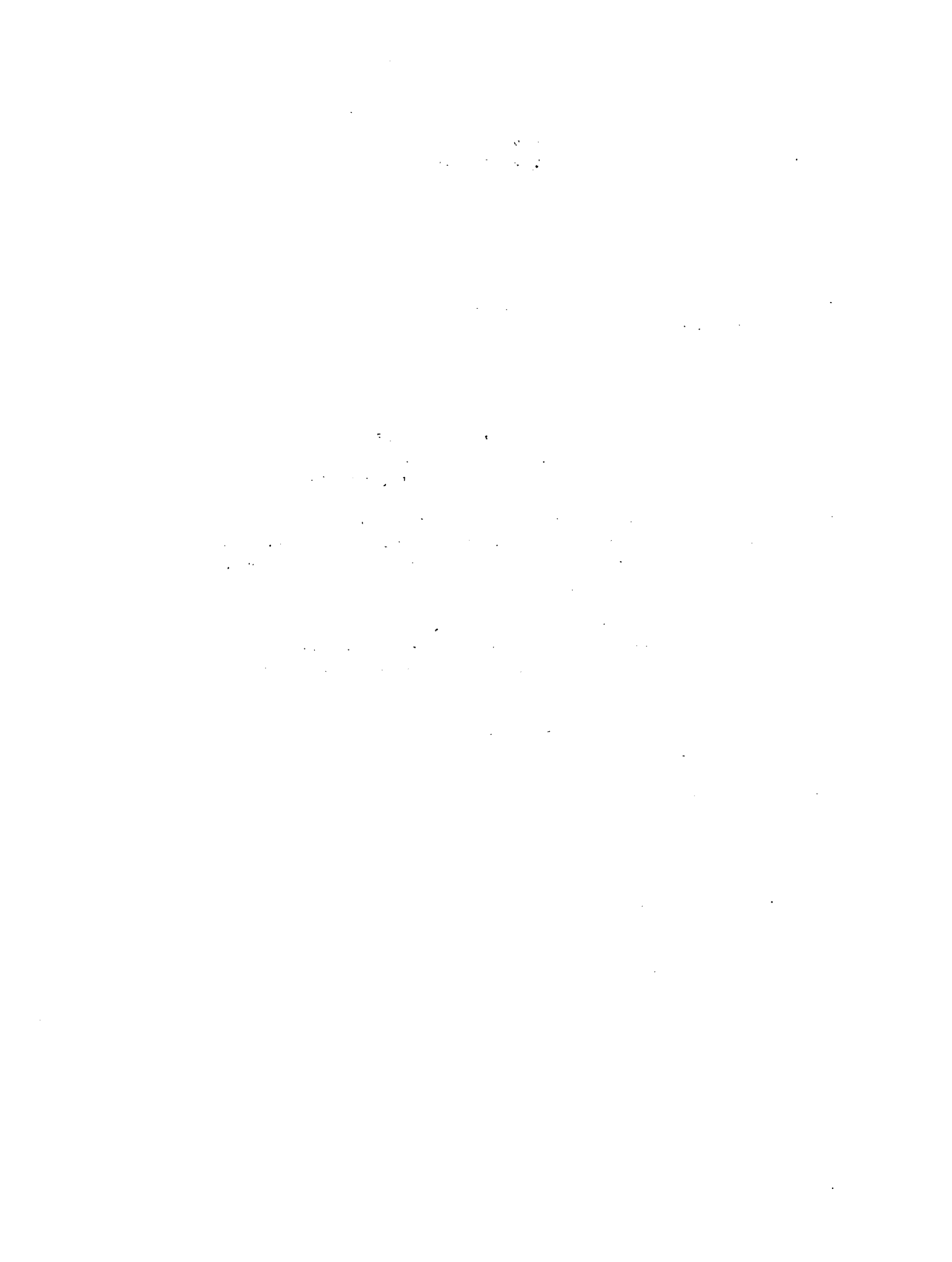
*IICA, as the specialized agency for agriculture of the inter-American system, focuses its actions on supporting its Member States in achieving sustainable agricultural development, within the framework of hemispheric integration and as a contribution to human development in rural areas. This has motivated IICA to support the ISEE, and the UNA to ensure that this Third Conference contributes conceptual elements and ideas for action that will enable nations to achieve sustainable development.*

*Inter-American Institute for Cooperation on Agriculture  
Area of Concentration on Science and Technology,  
Natural Resources and Agricultural Production*

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*José María Figueres Olsen*

PRESIDENTE DE LA REPUBLICA

October, 1994

Participants  
Third International Conference of Ecological Economics  
San Jose, Costa Rica

Dear friends:

I am delighted to welcome all the participants to the Third International Conference of Ecological Economics, "DOWN TO EARTH: Practical Applications of Ecological Economics" that is being organized by the International Society for Ecological Economics and the Universidad Nacional de Costa Rica.

For my country it is a particular honor to host this Congress since we are sure it will bring high quality scientists and policy makers preoccupied for the sake of our future generations. My government along with the whole Costa Rican society is moving towards solid sustainable development policies. In this regard, we see this event as a very important contribution to our country and our goals in this area.

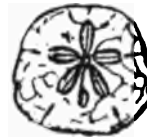
Best wishes for a productive Conference, successful contacts, and achievements of your objectives.

Sincerely,

A handwritten signature in black ink, appearing to read "José María Figueres Olsen", written in a cursive style.



UNIVERSIDAD NACIONAL



**ISEE**

International Society for  
Ecological Economics

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**TERCER CONGRESO MUNDIAL DE ECONOMIA ECOLOGICA SAN JOSE - COSTA RICA 24 - 28 Octubre 1994**

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October 24, 1994

Dear Colleague:

On Behalf of the Universidad Nacional and the International Society for Ecological Economics (ISEE), we welcome you to ISEE's third biennial meeting **Down to Earth Applications of Ecological Economics**.

This event was planned to emphasize the importance of operationalizing new concepts and approaches to ecological and economic issues that will enable human societies to prosper economically without destroying the earth's life-support system upon which they depend. By bringing together a wide spectrum of natural and social scientists, as well as policy makers, we hope to provide the opportunity for conference participants to discuss and synthesize their efforts to develop practical solutions to seemingly intractable problems at the local, national, and international level.

We, along with an organizing committee of international experts, have prepared what we feel is an important and timely program of speakers, technical sessions, roundtables, presentations, field trips and related activities. It is our hope that you will be able to play an important role in the development of new and innovative mechanisms that provide a more effective way of coping with a host of complex environmental and social problems. As the host country, Costa Rica is proud to welcome you to San José and we hope your experience here is both intellectually stimulating and enjoyable!

Sincerely,

Robert Costanza  
President, ISEE

Olman Segura Bonilla,  
Vice President for Meeting  
Planning, ISEE



*Universidad Nacional*  
"Campus Omar Dengo"  
**Rectoría**

**COSTA RICA**  
**1994**

*On behalf of the Universidad Nacional I am delighted to welcome you to the Third International Conference of Ecological Economics, **DOWN TO EARTH: Practical Applications of Ecological Economics.***

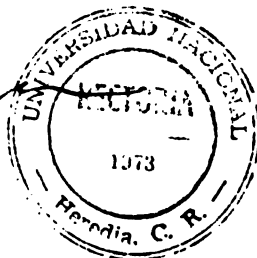
*This event is going to bring together scientists, resource managers, businessmen, and decision makers to discuss and advance in the process of looking for sustainable development. I believe this is an excellent opportunity to make an additional effort and explore possibilities for a new approach of economics to nature. Two previous conferences had been achieving important steps toward better understanding of all human kind, our challenge must be to take all these products, go deeper into theory, and convert them into practical applications.*

*I, along with the Organizing Committee, the whole group of experts who are preparing this Conference, believe it is an important moment to participate in the process of change that should not be delayed.*

*Welcome to Costa Rica and to the Conference.*

*Sincerely,*

**Rose Marie Ruiz Bravo**  
**President of Universidad Nacional**



## International Organizing Committee

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Herman Daly, USA  
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## Acknowledgements

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John Woodwell, USA  
Professional staff, Universidad Nacional, Costa Rica

## Una promesa a la Tierra

Basta ya, de maltratar al mundo  
y de trastornar el rumbo  
del entorno natural.

Basta ya, de la ambición que arruina  
y de la tecnología  
puesta al servicio del mal.

Vayamos al futuro  
con un sueño común:  
Devolver al planeta su virtud

**CORO:** Prometamos a la Tierra  
que vamos a batallar,  
por devolverle la vida  
que solíamos robar.

Prometemos a la Tierra  
que le vamos a cumplir  
Hagamos un compromiso  
por un mañana feliz.

Ya no más, a la civilización,  
que consume los recursos  
sin un asomo de amor.

Ya no más, a esta absurda economía,  
que derrocha la energía  
sin dar muestras de dolor.

Vamos ya,  
hagamos que todo cambie  
Forjemos un mundo nuevo,  
con el cual soñaba

**CORO**

## A promise made to Earth

Enough's enough, the Earth's been battered blue,  
churned and turned her nature  
into a witch's-brew;

Enough's enough, when ambitions burn  
to wrack the Earth to ruin -  
out tools we ply to wrong;

Let's make it to the future,  
together dream our way,  
by giving back our planet her dignity.

**CHORUS:** Let us take an oath for Earth,  
That we'll fight, and fight as one,  
And return to Earth life's treasures  
That we've robbed and robbed again;

... a promise made to Earth,  
That keeps until we're done:  
We stand - no compromise -  
For tomorrow's dawn to come.

Say, no more! to this world-society  
that consumes our ev'ry resource  
and shrugs the thought of love;

Say, no more! to this fool's economy  
that wastes, that bleeds our energy  
but never feels the pain;

Come on, love  
we've got to see through the change,  
we're forging the world a new way,  
reclaiming the call of Ghandi.

**CHORUS**



# Schedule of the conference

		Room
<b>Monday 24</b>		
8:00 - 10:15	<b>Opening ceremony</b> <ul style="list-style-type: none"> <li>● Rose Marie Ruiz, President of Universidad Nacional, Costa Rica</li> <li>● David Joslyn, Acting Director General, Inter-American Institute for Cooperation on Agriculture</li> <li>● Robert Costanza, President, International Society for Ecological Economics</li> <li>● Rodrigo Oreamuno, Acting President, Republic of Costa Rica</li> </ul>	Plenary
10:15 - 10:45	Coffee break	Lobby
10:45 - 10:50	<b>Kenneth Boulding Prize Award</b>	Plenary
10:50 - 12:30	<b>Envisioning sustainable alternatives</b> Moderator: Olman Segura Speakers: Donella Meadows, Alicia Bárcena, Enrique Leff	Plenary - 3
12:30 - 2:00	Lunch break	Hotel Herradura
2:00 - 3:30	<b>Workshops on envisioning sustainable alternatives</b> <ul style="list-style-type: none"> <li>● Environmental impacts of macroeconomic policies</li> <li>● Commerce and the environment</li> <li>● Increasing public awareness</li> <li>● Sustainability and inter-generational fairness</li> <li>● Forestry and sustainable development</li> <li>● The principles of ecological economics: views of economists</li> <li>● Development and the environmental commons: critical and "southern" perspectives</li> </ul>	El Bosque - 4 La Paz - 8 La Selva - 12 El Futuro - 14 Libertad - 16 Las Américas - 20 Girasol - 22
3:30 - 4:00	Coffee break	Lobby
4:00 - 5:30	<b>Workshops on ecosystems, biodiversity and development</b> <ul style="list-style-type: none"> <li>● Natural resource accounts: national, regional &amp; sectorial applications</li> <li>● Population and the environment: rethinking the consensus</li> <li>● What do communities need from ecological economics?</li> <li>● Water resources and economic valuation</li> <li>● Agro-ecosystems and sustainability</li> <li>● Sustainable development &amp; structural change in Benin, Bhutan, Costa Rica &amp; The Netherlands</li> <li>● Environment related issues in the African context</li> </ul>	El Bosque - 25 La Paz - 28 La Selva - 30 El Futuro - 33 Libertad - 37 Las Américas - 41 Girasol - 42
7:00	<b>Opening night mixer</b>	
7:00	<b>Film: Ecological Design: A View to the Future</b>	La Paz

## Tuesday 25

8:00 - 10:15	<b>Ecosystems, biodiversity and development</b> Moderator: Marflia Pastuk Speakers: Susan Hanna, Máximo Kalaw Jr., Anil Gupta	Plenary - 47
10:15 - 10:45	Coffee break	Lobby
10:45 - 12:30	<b>Social and ethical dimensions of ecological economics</b> Moderator: Marflia Pastuk Speakers: Rodrigo Gámez, Sixto Roxas	Plenary - 49
12:30 - 2:00	Lunch break	Hotel Herradura
2:00 - 3:30	<b>Workshops on social and ethical dimensions of ecological economics</b>	
	<ul style="list-style-type: none"> <li>● Reconceptualizing development in the context of sustainability</li> <li>● Sustainability and employment</li> <li>● Institutional transformation</li> <li>● Ecotourism and national parks</li> <li>● Power, prices and ecological distribution</li> <li>● Valuation conflicts and ecological economics</li> <li>● Ecology and economy in the Caribbean Basin</li> </ul>	<ul style="list-style-type: none"> <li>El Bosque - 52</li> <li>La Paz - 56</li> <li>La Selva - 57</li> <li>El Futuro - 63</li> <li>Libertad - 68</li> <li>Las Américas - 72</li> <li>Girasol - 75</li> </ul>
3:30 - 4:00	Coffee break	Lobby
4:00 - 5:30	<b>Workshops on sustainable agro-ecosystems</b>	
	<ul style="list-style-type: none"> <li>● Equity related to trade</li> <li>● Water resources and energy alternatives management</li> <li>● The role of the media and ecological economics</li> <li>● Coastal and marine resources management</li> <li>● Developing biophysical models for resource management in LDCs</li> <li>● The political economy of gender, environment and development</li> <li>● Rural development and sustainable land use policies</li> </ul>	<ul style="list-style-type: none"> <li>El Bosque - 78</li> <li>La Paz - 82</li> <li>La Selva - 86</li> <li>El Futuro - 88</li> <li>Libertad - 91</li> <li>Las Américas - 93</li> <li>Girasol - 95</li> </ul>
6:30	<b>Business meeting</b>	La Paz
7:00	<b>Open dialogue with peasants and indigenous groups from Costa Rica</b>	Girasol
8:00	<b>Ecological economic course roundtable:</b>	
	<ul style="list-style-type: none"> <li>● Revising the old, inventing the new</li> </ul>	Las Américas
8:00	Folkloric fantasy	Melico Salazar Theater (San José City)



## Wednesday 26 : Scientific field trips (T-shirt day)

- 7:00            **Film: Natural Parks of Costa Rica and Natural Resources**            La Paz
- 8:00            **Presentation of the book: *Ecología y Capital***            Las Américas

## Thursday 27

- 8:00 - 10:15 **Sustainable agro-ecosystems**            Plenary - 100  
 Moderator: Robert Costanza  
 Speakers: Ariel Lugo, Gilberto Gallopín, Miguel Altieri
- 10:15 - 10:45 **Coffee break**            Lobby
- 10:45 - 12:30 **Creating the institutional setting for sustainable development**    Plenary - 103  
 Moderator: Robert Costanza  
 Speakers: Johannes Opschoor, Alvaro Umaña
- 12:30 - 2:00 **Lunch break**            Hotel Herradura
- 2:00 - 3:30 **Workshops on creating the institutional setting for sustainable development**
- Modeling the ecological economic determinants of human carrying capacity            El Bosque - 105
  - Biodiversity and development: restoration            La Paz - 109
  - Resiliency in natural and economic systems            La Selva - 113
  - Human settlement and sustainability            El Futuro - 113
  - Energy, entropy and time: ecodynamic approaches            Libertad - 116
  - Valuation and ecological economics            Las Américas - 120
  - Business at the corporate level and ecological economics            Girasol - 126
- 3:30 - 4:00 **Coffee break**            Lobby
- 4:00 - 5:30 **Workshops on financing sustainable development**
- Contributions of evolutionary, organizational and institutional economics to ecological economics            El Bosque - 131
  - Clean technology            La Paz - 135
  - Natural resources accounting and sustainable development            La Selva - 140
  - Indicators of environmentally sound and sustainable development            El Futuro - 144
  - Sustainable technologies and institutions            Libertad - 150
  - Financial mechanisms to achieve sustainability            Las Américas - 154
  - Pesticide issues and ecological economics answers            Girasol - 156
- 8:00            **Society banquet & dance**            La Paz

## Friday 28

8:00 - 10:15	<b>Financing sustainable development</b> Moderator: Juan Martínez-Allier Speakers: Marc Dourojeanni, Osvaldo Sunkel, Karl-Henrik Robert	Plenary - 158
10:15 - 10:45	Coffee break	Lobby
10:45 - 12:30	<b>New perspectives</b> Moderator: Juan Martínez-Allier Speakers: Joseph Tainter, Paul Ekins	Plenary - 161
12:30 - 1:00	<b>Closing ceremony</b> <ul style="list-style-type: none"><li>● Olman Segura, General Coordinator of the Conference</li><li>● Carlos Murillo, Director Economy Policy Masters Program, Universidad Nacional, Costa Rica</li><li>● Robert Costanza, President of ISEE</li><li>● José María Figueres, President, Republic of Costa Rica</li></ul>	Plenary
1:00 - 2:00	Lunch break	Hotel Herradura
2:00	<b>Institutional visits</b>	

**A**bstracts



## Envisioning Sustainable Alternatives

As the consensus for sustainability gathers momentum around the world, a precise idea of what a sustainable world might look like becomes increasingly important. Sustainable alternatives to a wide-range of current practices are needed in order to reverse present trends in environmental degradation and economic imbalance. This theme will present an examination of how the ecological economics community envisions the transition to a sustainable future.

### Panelists

1. Donella Meadows, *Dartmouth College*, United States
2. Alicia Bárcena, *Earth Council*, México
3. Enrique Leff, *United Nations Environment Programme*, México

Chair: Olman Segura, *Universidad Nacional*, Costa Rica

### Time lags, overshoots, and nonlinearities: the perverse dynamics of resource management

Donella Meadows  
*Dartmouth College*  
United States

Given its disciplinary establishment before computers, before nonequilibrium thermodynamics, and before chaos theory, economics has a tradition of focusing on well-behaved, linear, equilibrating, mathematically solvable phenomena. Though mathematical economics has become modern and even arcane, the residue of this tradition still affects economic thinking. It shows up particularly in naive beliefs about how markets and technologies will automatically, directly, and in a timely fashion, solve resource problems.

This presentation will use very simple dynamic simulations to argue for much more systematic attention to the presence of disequilibria, nonlinearities, time lags, overshoots, and other mathematically messy properties of the real world, especially as they manifest in resource and environmental systems. It will conclude with an explanation of what makes the World3 model (of *Limits to Growth* and *Beyond the Limits*) crash -- and the question of whether those properties are also present in the global economic system.

## Envisioning Sustainable Alternatives

### Environmental Impacts of Macroeconomic Policies

#### Panelists

1. William Postigo de la Motta: *Development strategy, macroeconomic policies and the environment*
2. Jorge Torres Zorrilla: *Agricultural modernization and resource deterioration in Latin America*
3. Mohan Munasinghe, Wilfrido Cruz and Jeremy Warford: *Environmental impacts of countrywide policies; an overview*
4. David Reed: *The impact of structural adjustment on the environment*
5. Peter Doberns: *The roles of the political control in the development of sustainable societies*
6. A. Persson and Mohan Munasinghe: *Forest management and economywide policies in Costa Rica*

**Chair:** Mohan Munasinghe, World Bank, United States

#### Development strategy, macroeconomic policies and the environment

William Postigo de la Motta  
Universidad Nacional Agraria La Molina  
Perú

The implementation of Structural Adjustment Programmes (SAP) with the support of the World Bank and the IMF has raised many criticisms. The policies promoted by SAPs have involved the change of development strategy towards export-led economic growth policies, liberalization of the economy, and the dismissal of a significant role for the state in the process of economic development. Devaluation of the national currencies has been a policy widely used in countries where SAPs have been implemented.

The criticism of SAPs has been centered mainly on the argued negative impact of SAPs on economic growth and poverty. Most recently, the criticism has been extended to a supposed negative impact of SAPs on the environment. The World Bank has responded this criticism stating that, SAPs have had - on balance- a positive impact on the environment.

This article revises the arguments for an against a positive impact of macroeconomic policies which are a central part of the strategy of export-led growth. The case of the impact of macroeconomic policies of SAPs on soil erosion is taken as an example. The theoretical model developed by Girma (1992) to analyze the macroeconomy-environment links is extended in order to look at the impact of devaluation of the national currency on the natural resource use, i.e. on soil erosion. The conclusion is that there is no conclusive evidence to argue a negative or positive impact of macroeconomic policies of SAPs on the environment. This is because the links between macroeconomic policies and the environment are only indirect and, therefore, the impact of macroeconomic policies in a strategy of export-led growth depends on the specific situation of the country involved. In certain countries, and for certain crops or regions, the impact may be negative;

while in other instances the same policies may have a positive impact. Another conclusion is the

need of a significant role of the state for environmental regulation and control.

## **Agricultural modernization and resource deterioration in Latin America**

**Jorge Torres-Zorrilla**  
*Inter-American Development Bank*  
Ecuador

This study presents concrete evidence that resource deterioration is taking place in the most dynamic subsector of the agricultural sector in Latin American countries. First, the most successful experiences of agricultural modernization are described. Then, the environmental assessment of these export-oriented modernization processes are presented. Finally, the need for alternative policies to ensure resource conservation and a sustainable and competitive agriculture are discussed.

The modernization process of LA agriculture is identified by sustained increases of productivity and net income at the enterprise level. The important factors explaining the process are Policies Markets Technology and Organization & Management. The eight case-studies supporting these findings were: grains in Argentina, soybean in Brazil, flowers in Colombia, dairy products in Costa Rica, fruits in Chile, shrimps in Ecuador, vegetables in Mexico, and citrus in Brazil.

The environmental assessment (EA) of the case-studies conducted to the identification of some common impacts on natural resources and the environment, leading to classification under four different categories: a) processes with strong effects on deforestation (soy in Brazil and livestock in Costa Rica); b) processes with great impact on basic agricultural resources (soil deterioration for Argentina's grains, water depletion for Colombia's flowers); c) processes with greater effects on chemical pollution (Chilean fruits, Mexican vegetables, and Brazilian citrus); and d) processes with strong impacts on wetlands (shrimps in Ecuador).

The general policy guidelines is that the environmental problems of agricultural modernization are not solved reverting the export orientation policy,

but facing directly the most common sources of economic distortions: externalities and common-property resources.

The EA showed three market limitations that provide private economic incentives to over-exploitation of resources and create disincentives for protection: low value assigned to ecological capital, strong distortions between private and social benefits and costs, and a high market discount rate. Modernized private enterprises are motivated by profit maximization and, unless they are convinced that resource deterioration affects profits, protection will have low priority. Regarding common property resources the private enterprise will try to avoid any responsibility.

Government policies to promote resource conservation on behalf of society and internalization of all externalities by private firms are then discussed. The basic policy instruments to induce sustainable agricultural development are: a) macro-policies: a real exchange rate policy to make sustainable projects more profitable and the use of agrochemicals less profitable; a low real interest rates policy to make long-run investments more profitable; a low-and-flat tariff policy to make sustainable investments more profitable, b) sectoral policies: food price liberalization to make agriculture more profitable promoting conservation; a high price for irrigation water to induce its efficient use; elimination of subsidies on fertilizers and pesticides to induce its prudent use; granting land titles to small farmers to induce conservation, d) social policies and government programs: education to raise environmental consciousness; defence of ecosystems (forests, wetlands, biodiversity); controlling water pollution; defending human health; controlling soil deterioration; and preventing social conflicts.

## The impact of structural adjustment on the environment

David Reed  
World Wildlife Fund  
United States

Conventional theories of political economy define the scope of this discipline as a study of how the state and political processes affect the production and distribution of wealth. Further, political economy is a study of how economic forces influence the exercise of political power and the international distribution of power and force. The political economy of the environment examines how the environment influences the production and distribution of wealth and how influences the functions of the state and political processes. Conversely, political economy of the environment examines how political and economic forces determine access to and use of environmental goods and services.

Structural adjustment directly effects the political economy of the environment in adjusting countries. Economic reforms change the relative prices in a country, shift relations among economic sectors, and deepen integration of developing country economies into the global market system. These economic reforms also alter power relations within adjusting societies. In addition, these society wide reforms changes have a direct impact on how the economy uses its natural resources base and the conditions under which social groups have access to and derive benefits from the environment. Structural adjustment also influences the environment because:

- pursuit of enhanced economic efficiency in the market system generates environmental externalities positive and negative

- design and implementation of adjustment programs reflect social and generational interests that have direct consequences, often negative, for the natural resource of adjusting countries.

My presentation will apply this analytical framework of the case studies examines in WWF's two research programs. Carried out in 12 countries, those studies documented the linkages between structural reforms and the environment. The presentation will examine, among others, specific cases in which:

- structural reforms enhanced social welfare and intergenerational equity through improved environmental management

- structural reforms improved short-term efficiency but exacerbated long-term environmental degradation to the detriment of future generations

- privileged social sectors used natural resources to attenuate social discontent of poorer social sectors during the adjustment process

- privileged social sectors benefitted from structural reforms by perpetuating or deepening their control over natural resources to the detriment of the poorer social sectors and future generations.

The presentation will discuss the implications of this analysis for national level policy reforms and will conclude with recommendations on how to address these challenges.



## **The roles of political control in the development of sustainable societies**

**Peter Dobers and Rolf Wolff**  
*Gothenburg Research Institute*  
Sweden

Political control is an important mean to fight environmental pollution. This presentation will give an insight of the results of a comparative study of different governmental activities to create an institutional setting for a sustainable society in Sweden. Thereby, two control philosophies can be identified that lead to different, however complementary, governmental activities, by which sustainable societies can be achieved.

First, there is environmental legislation, by which emission limits are set and which are enforced by local municipalities. Tuff enforcement tend to lead to a conflict in the relationship between governmental bodies and the polluting industry. However, control

and command is necessary when it comes to large pollution sources, but embody a distrust towards industry.

Second, there are governmental instructions, by which regional environmental problems are addressed. Such instructions go beyond national regions and look for practical, hands-on solutions. Industry and its inherent competence are trusted, and a favorable culture of joint development of environmental solutions is created. Hereby, the role of municipalities is changing from a control authority and is complemented with the role of being an important and competent actor of a sustainable society.

## Envisioning Sustainable Alternatives

### Commerce and the Environment

#### Panelists

1. Cees van Beers and Jeroen C.J.M. van den Bergh: *International trade, natural environment and economic growth: questions, methods and results*
2. Jürgen Meyerhoff and Birgit Soete: *International trade and material flows: controlling problems*
3. Ronaldo Seroa da Motta: *Environmental standards, revenue raising and pollution tax: a simulation for Tiete River Basin in Brazil*
4. Mark T. Brown: *Energy, foreign trade and the welfare of nations*

Chair: **Rodolfo Quirós Guardia**, *Inter-American Institute for Cooperation on Agriculture*,  
Costa Rica

#### International trade, natural environment and economic growth: questions, methods and results

Cees van Beers and Jeroen C.J.M. van den Bergh  
*Free University*  
The Netherlands

The 1980s have shown a widespread concern for global issues and long term environmental phenomena. This has led to many reflections on the concept of sustainable development. Neglected in this process has been specific attention for the relationship between foreign trade and environmental quality. This is odd in view of the fact that solutions to many pressing environmental problems require that a more central role in analysis be given to international economic relations.

The aim of this article is to survey, categorize, and compare attempts at examining the relationship between foreign trade and environment. These will be dealt with systematically, by putting forth a logical list of questions, followed by a treatment of different theoretical and empirical approaches. The questions are based on three types

of interactions between trade and environmental variables: i) the impact of spatial distributions of environmental resources on international trade flows; ii) the effect of international trade policy on environmental quality; and iii) the international repercussions of environmental policy. A very important question that ultimately needs an answer is to what extent overlap or synergy can be expected in pursuing environmental and trade policies. The paper goes along by presenting a summary of the main conclusions from various theoretical and applied studies, along with an account of missing links and gaps in the literature. This will be done by comparing the list of questions to the results obtained from the literature. Finally, we provide suggestions for new lines of analytical research on the relationship between international trade and environment.

## International trade and material flows: controlling problems

Jürgen Meyerhoff and Birgit Soete  
*Institut für Ökologisch Wirtschaftsforschung gGmbH*  
Germany

The paper aims at showing possibilities of controlling material flows caused by international trade.

According to Samuelson, the only statement possible about the volume of international trade is that a certain amount of trade is better than no trade at all. Yet, about the "right" extent of trade, nothing can be said from the economic point of view (Ekins et al, 1994). From an ecological point of view, however, it might be advisable to define the extent of and, therefore, limitations to international trade. In the context of attempts at the operationalization of the concept of Sustainable Development, a cristalization of scientific approaches like material flow analysis or Ecological Footprints can be observed.

The central affirmation of the material flow approach is that the antropogenetically caused material flows have reached not only a qualitative but, above all, a quantitative extent which can contribute considerably to the destabilization of presently given environmental states. "Thanks to human industrial and economic activities, the fluxes are no longer in balance and the reservoirs are changing rapidly in geological terms. Eventually, new balances may be achieved. But these new balances are not favorable to man because they shift away from the ecological situation within which man originally evolved. Waldsterben, the ozone hole, and climatic changes could serve as examples" (Schmidt-Bleek 1993).

Free trade is economically substantiated by comparative cost advantages (Ricardo) and the theorem of factor proportion (Fleckscher/Ohlin). Central is here that through division of labor and specialization the welfare of the trading nations is increased. It can be recognized that since World War II liberalization of foreign trade and income growth have contributed to an immense growth of international trade. Based on these experiences, a further promotion of international trade is expected to

bring about growth impulses and welfare increases in the respective national economies. Steps in this direction can be seen in the removal of trade barriers (Uruguay Round GATT) and the establishment of new regional tradesmen (NAFTA) respectively their enlargement extension of the EU). Furthermore, countries like China and Russia work on their integration in international trade.

Therefore, economically intended and ecologically necessary development diverges diametrically: on the one hand the expansion of trade inducing economic growth and with that an increase in material flows which -according to current ecological insights/findings- lead to further destabilization of global "equilibria". On the other hand, if one took seriously the above mentioned 50% reduction of material flows as a starting-point for sustainable development, international trade would have to contract/decrease. Thus, the question rises of how this ecological target can be integrated in the economic system.

A conventional demand is the influencing of international trade through the correction of relative prices (ef. f. ex. Hinterberger 1993, p. 428). By means of internationalization of the ecological costs a reduction of trade respectively material flows to an ecologically more digestible extent is to be brought about -a well-known approach from the economic point of view.

In the paper, we discuss whether the reduction of material flows can be reached by employing traditional instruments of environmental economics such as charges and certificates. It is shown that in the international context, additional institutions are necessary for realizing the environmental objective. It becomes clear that a "Greening of GATT" is not by far sufficient for re-designing world trade for sustainable development. Thus, it is shown what kind of demands such an above mentioned new institution would have to fulfill.

## **Environmental standards, revenue raising and pollution tax: a simulation for Tiete River Basin in Brazil**

Ronaldo Seroa da Motta  
*IPEA*  
Brazil

The use of market-based instruments (MB), as pollution taxes, has been advocated to be a more efficient approach to environmental policy than the traditional command and control instruments (C&C) applied worldwide. Moreover, MB have also been regarded as an important instrument of revenue raising to promote funding for sustainable activities. However, the implementation of MB is not trivial and, apart of institutional and legal aspects, issues related to their integration with the prevailing environmental standards and the resulting revenue need to be carefully examined. This paper develops a model to simulate the application of water industrial pollution taxes in the Tiete river basin in the Sao Paulo state in Brazil where is located one of the most concentrated industrial sector in the country.

The main aim of MB is to achieve, at the least social cost, a reduction of total pollution, say, in a basin, imposing different levels of control in the plants contributing to the discharge in the area. Firms decide their individual abatement level according to the difference between tax and control marginal costs. The model developed in this study generates results for the typical C&C when all plants are compelled to abate according to the target set by the environmental authority (environmental

standards) and also the estimates for MB when plants can choose either to abate or pay tax on emissions below the legal target. Results will indicate that targets must be reduced when tax increases in order to achieve a certain final abatement level for the basin as whole. As target is a proxy of standards, policies seeking fiscal revenues must set lower tax with high target levels. Since a high tax will viabialize pollution abatement investments in those heavy polluters firms with high marginal abatement costs, the size of fiscal revenue is not only linked to the level of taxation but as a result of a combination of tax and target levels. As will be analyzed, larger target with lower tax levels alter the sectoral distribution of abatement. Consequently, the distribution of costs and revenues will also be different. The conclusions will confirm that the decision of introducing a market based instrument certainly leads to lower abatement costs than those observed in a command and control approach. However, if a certain level of final abatement for the basin is determined, policy makers will have to take into account that environmental standards to be imposed on individual plants are also a key parameter to define the level of abatement and the respective costs.

## **Energy, foreign trade and the welfare of nations**

Mark T. Brown  
*University of Florida*  
United States

Both mathematical and theoretical models developed for resource management are explored using data from Costa Rica and other tropical economies. An emergy basis for value is presented and related to welfare of populations and as a means

of quantitatively making public policy decisions. The economy of Costa Rica is evaluated using emergy analysis techniques and indices of development and resource management are compared with other countries. Subsystems of the economy are evaluated

and questions regarding resource management and sustainable use are discussed.

The welfare of nations depends on wise resource management, sustainable resources use, and maintenance of favorable trade relationships. Using emergy as a common denominator we are able to shed new light on each of these components of

the national economy. A resources' contribution to an economy is inverse to price. Sustainable use is better related to a negative discount rate, and trade is best balanced when the economic "effect" of traded commodities between partners are equal. Mathematical models are given to explore the relationships of resource management, sustainable uses and trade to economic well being.

## Envisioning Sustainable Alternatives

### Increasing Public Awareness

#### Panelists

1. Friedrich Hinterberger: *Environmental prospects and workable policy rules: on the feasibility of environmental policies*
2. Ron Leger and John O'Connors:
3. Noel Payn: *Our stewardship in a changing world*
4. Leonardo Garnier:

Chair: Alicia Bárcena, *Earth Council*, Costa Rica

#### Environmental prospects and workable policy rules: on the feasibility of environmental policies

Friedrich Hinterberger  
*Wuppertal Institute*  
Germany

In recent years informational questions of policy steering have been playing a more important role in the debate of environmental policy. Guidelines as are provided by hard core environmental economics - and the allocation optimum as a key concept - proceed on the assumption that a high informational basis is available when it comes to look for appropriate instruments. Yet, there seems to be little hope for gaining a sufficient information basis, which, in turn, gives rise to a search for new guidelines or policy rules which demand a much lower level of readily information.

In part I, we give a new evaluation of the informational requirements needed for a workable political strategy in traditional environmental economics. We argue that our knowledge on what affects the stability of any environmental policy which is based on the optimal allocation of resources. The concept of first best solutions as a guideline for environmental policy is highly questionable both for practical and theoretical reasons. Thus a theoretical reorientation is on the agenda. In part II we offer an alternative policy concept which systematically neglects any connection to allocation theory. Instead

of "internalizing external effects" our pragmatic solution will aim at lowering the potential of damage ignoring the (unknown) actual damage.

More in detail, we argue in part I that the individualistic bias of environmental economics has led to a systematic neglect of informational questions in environmental policy. In this concept, economic agents have to decide on how to define and quantify the dimension of external effects. Yet, following this well-known approach, we need a background of common knowledge when it comes to assess the dimension of external effects in a politically meaningful way. The question of the "true" dimension of ecological problems will be answered quite differently depending on the actual quality of ecological knowledge. Normally, we will expect an open (and unlimited) set of cases requiring intervention. On the other hand, with regard to the present uncertainty concerning true ecological damage a public (not private!) assessment of the available ecological knowledge at hand has to be the starting point of ecological policy. There seems to be no first best solution, not even in a theoretical way!

Yet, the following questions arise:

- How shall we master the uncertainty about the "true" dimension of ecological damage?
- How shall we handle an open set of cases requiring political interventions?

We hold: we need pragmatic political guidelines covering a growing set of possible cases requiring intervention. Far away from being optimal, such rules have to be developed in order to master environmental damage. In absence of an optimal solution, pragmatic solutions have to be considered as first best solutions.

In part II, we explore this point more in detail. We argue that first of all we need estimates of the environmental impact potential. Besides the availability of resources and the danger coming from hazardous emissions and wastes, it is the carrying capacity of different ecosystems and the complexity of global fluxes such as the carbon cycle that complicates the operationalization of the environmental impact potential. However, one should consider nature not only as a "life support system" for man. Sustainability should also be interpreted towards a long-term co-existence of human and other beings (that are no pathogens or parasites of course).

## **Envisioning Sustainable Alternatives**

### **Sustainability and Inter-generational Fairness**

#### **Panelists**

1. Paul Thompson: *Intergenerational justice and development ethics*
2. Bryan Norton: *Intergenerational equity, the distance problem and the asymmetry of time*
3. Baylor L. Johnson: *Sustainability and intergenerational fairness*
4. Talbot Page:

**Chair:** Paul Christensen, *Hofstra University, United States*

#### **Intergenerational justice and development ethics**

Paul Thompson  
*Texas A & M University*  
United States

Although philosophers and economists have jointly engaged the problem of intergenerational justice through a debate over discounting and rights of future generations, development economics presents an alternative theoretical approach to the future. Recent work in development ethics has engaged economists over the goals and criteria for development in a manner that might be fruitfully integrated with the debate over resources and environmental quality. In particular, the welfarist assumptions of development economics are being reexamined. This paper focuses on one component of this work.

The Brandt and Brundtland reports of the 1980's were political documents intended to redress development and environmental problems on a global basis. Both report implicitly reject welfarist criteria for development. The Brandt replaces them with a philosophical framework based on rights claims, but the Brundtland report repeats many substantive claims of the Brandt report while basing them on a philosophical framework of interests. This paper makes the nature of this philosophical difference between the Brandt and Brundtland efforts explicit, and presents an argument for regarding the Brundtland report as more amenable to an analysis of environmental issues.



## **Intergenerational equity, the distance problem, and the assymetry of time**

Bryan Norton  
*Georgia Institute of Technology*  
United States

It is impossible to provide a coherent conceptual account of sustainability in the absence of a coherent account of intertemporal/cross-generational moral obligations. Some philosophers (such as John Passmore) and most economists have accepted an important simplification of the problem of intergenerational equity. According to this simplification, any generation can adequately discharge its obligations to all of the future, provided the immediately next generation is as well off as the prior one was. This simplification assumes that we

can meaningfully aggregate welfare within generations and compare it across generations. This simplification will be called into question because it cannot capture important intuitions regarding intergenerational justice and because, it will be argued, no reduction of future values to the present can adequately capture the multi-scalar nature of human obligation. A scale-sensitive alternative to single-generation ethics -- one that recognize three scales of human concern -- will then be proposed and defended.

## **Sustainability and intergenerational fairness**

Baylor L. Johnson  
*St. Lawrence University*  
United States

Mainstream modern economics cannot accurately evaluate the needs of future generations, nor even the concern of the present generation for the future. The theory of value embodied in modern economics is designed to represent evaluations of pure commodities, and fails to accurately register other values. In particular it does not capture our evaluations of the various environments -- social, political, natural -- within which commodity evaluations and transactions take place.

Our most important bequests of the future are not individual things, but these environments. We cannot leave our descendants infinitely open choices.

We serve future generations best by preserving their options, i.e. by leaving them maximum chances to reject our choices. This entails a focus on bequeathing healthy environments, where health entails complexity, diversity, beauty, and capacity (though not the necessity) for homeostasis.

Whatever we wish to bequeath to the future, economic theory must better incorporate the effects of economic theory and practice on larger environments, and economic activity must be limited and channeled to better preserve environmental health.

## Envisioning Sustainable Alternatives

### Forestry and Sustainable Development

#### Panelists

1. Pablo Campos Palacín: *Economics and conservation of Mediterranean forest in the Iberian Peninsula*
2. David W. Pearce, Neil Adger, Katrina Brown, Raffaello Cervigni and Dominic Moran: *Capturing non-timber values of Mexico's forest sector*
3. Douglas E. Booth: *Preserving old-growth forest ecosystems: valuation and policy*
4. Herb Hammond and Tom Bradley: *Ecosystem-based planning to protect biodiversity, domestic watersheds, and the economy in the Slocan Valley of British Columbia, Canada*
5. Maarten Kappelle: *Management of montane secondary forests in Costa Rica: an environmentally-sound socioeconomic alternative?*

**Chairs:** Jorge Camacho and María de los Angeles Alfaro, *Universidad Nacional, Costa Rica*

#### Economics and conservation of Mediterranean forest in the Iberian Peninsula

Pablo Campos Palacín  
*Consejo Superior de Investigaciones Científicas*  
Spain

The Mediterranean forest in the Iberian Peninsula, called "Dehesas" and "Montados" in Spain and Portugal, respectively, occupies 10 million hectares, although more than 50 per cent of this area is deforested because of human activity.

The "Dehesas" and "Montados" are agroforestry systems generated by extreme conditions in rainfall and high temperatures during the summer. Soils are poor and acid. As a result, farmers rear local breeds ("Retinta" and "Morucha" cows, "Merina" sheep, Iberian pigs, etc.) which have adapted to the pastures which are available in this area.

The crisis of private profitability in cattle farming makes difficult the traditional management of the "Dehesas" and "Montados" and encourages the re-evaluation of new activities, like hunting,

environmental services (green tourism, genetic reserve, carbon fixation, etc.) and "typical" quality productions.

This paper presents the economic results of a qualitative environmental matrix of one sample taken at "Dehesa" and "Montado" (Research Project European Union CT90-0028 on Technical and Economic Analysis of the Dehesas and Montados Systems).

The results show that private profitability, with no public intervention, is decreasing or negative, whereas social profitability (externalities) is increasingly positive. These results justify interest in providing compensation for the environmental benefits of the "Dehesas" and "Montados".

## **Capturing non-timber values of Mexico's forest sector**

David W. Pearce, Neil Adger, Katrina Brown, Raffaello Cervigni and Dominic Moran  
*University of East Anglia*  
England

Mexico's forests have significant unpriced value, which does not accrue to those managing the forests, and which would affect management decisions if the values were captured. This paper provides broad orders of magnitude for several non-timber uses of forests, including direct uses (non timber forest products, tourism) indirect or functional services of forests (carbon sequestration and watershed protection), and option and existence values of maintaining forests for future generations. The results suggest that non-timber values have a global dimension which Mexico might capture given the right institutional framework.

The paper, therefore, analyzes some instruments which could enable the international community to express its willingness to pay for conserving forest resources. These are entrance fees for tourism resorts, easements and franchise agreements, debt for nature swaps, carbon offsets, contracts for biodiversity prospecting. Significant recent constitutional and legislative amendments to the national land tenure regime are reshaping forest management priorities and, therefore, the potential for non-market benefit maximization.

## **Preserving old-growth forest ecosystems: valuation and policy**

Douglas E. Booth  
*Marquette University*  
United States

How should old-growth forest ecosystems be valued and what specific policies should be instituted for preserving or exploiting old growth? In responding to this question, many economists would argue that the appropriate framework for valuing old growth should be cost-benefit analysis. If the benefits of preservation exceed the cost, preservation should be undertaken; if not, old-growth forests should be exploited. However, if ecosystems are perceived by some to be valuable for their own sake and thus have moral standing, then the cost-benefit approach may no longer be appropriate. Individuals giving testimony in congressional field hearing on the preservation of old growth in the Pacific Northwestern section of the United States have over the past 40 years increasingly expressed the view that old-growth forest ecosystems are valuable in their own right and are of moral concern.

A central goal of this paper will be to argue that cost-benefit analysis is an inappropriate valuation criterion when individuals view old-growth ecosystems as morally considerable. The essence of the argument will be that cost-benefit analysis treats old-growth ecosystems as instruments that provide utility to human beings, and that this is inconsistent with viewing old-price, but moral beings are priceless.

Rejecting cost-benefit analysis as a valuation criterion does not solve the issue of whether or not old growth should be preserved. It simply re-casts the problem as a moral dilemma. Should old growth be preserved and those who would gain their livelihood from its exploitation be harmed? Or, should such harm be avoided through the exploitation of the ecosystem? For a concrete approach to policy in the case of old growth, or any other ecosystem preservation issue, an ethical standard is needed to

suggest such a standard and to offer possible measures for implementing it in the case of

old-growth ecosystem preservation in the Pacific Northwest.

## **Ecosystem-based planning to protect biodiversity, domestic watersheds and the economy in the Slocan Valley of British Columbia, Canada**

**Herb Hammond and Tom Bradley**  
*Silva Forest Foundation*  
Canada

The Silva Forest Foundation, a charitable society, is working with grassroots community groups to analyze and plan the 340,000 hectare forested Slocan River drainage in southeastern British Columbia, Canada. Timber extraction is a major contributor to the economy. However, the clean environment and outstanding scenic and wilderness values in the area have contributed to rapid growth of tourism and small businesses. Many residents live a near-subsistence life style that depends, in part, on small scale agriculture. Residents take their drinking and irrigation water from the small drainage basins that make up the larger Slocan Valley.

Over the past 15 years, conflict has been intense between logging company plans for timber extraction and residents' desires to protect water, to maintain economic options other than timber, and to maintain the environmental quality of their home.

The project applies ecosystem-based planning that is based upon principles of landscape ecology and conservation biology. The principles of ecological economics are applied through total cost accounting. A computer-based Geographic Information System (GIS) is used to analyze complex

combinations of ecological and economic variables, and to produce a broad range of options and usable products.

The project results in a community-developed, ecosystem-based plan that includes:

- a protected network of ecosystems that provides linkages across the landscape.
- human use zones and standards for ecologically responsible uses within these zones.
- economic analysis and options for a diverse, sustainable economy.
- ecological and economic analysis of existing forest uses and plans.
- a transition strategy for implementing the ecosystem-based plan.

The planning process used in this project, whether performed manually or with GIS, can be used by communities anywhere in the world to maintain fully functioning ecosystems, and to develop diverse community-based economies.

## Management of montane secondary forests in Costa Rica: an environmentally-sound socioeconomic alternative?

Maarten Kappelle  
University of Amsterdam  
The Netherlands

In the montane forest belt (> 2000 m alt.) of the Los Santos Forest Reserve in Costa Rica's Cordillera de Talamanca, the outcome of an assessment of current socioeconomic activities was integrated with baseline data from an ecological study carried out in primary and secondary oak forests.

On the one hand, socioeconomic and agroecologic results show that actual and use practices, including charcoal production, dairy cattle-raising, potato cultivation and fruit-tree growing, are far from sustainable, as they induce forest clearing, soil compaction and erosion, water shortage and pollution through over-use of pesticides. At the same time reforestation activities at the farm level in the area are few and involve mainly exotic, soil-degrading tree species (e.g. *Cupressus* and *Eucalyptus*). On the other hand, plant ecological results show that abandoned pasturelands give way to a process of forest recovery (succession) leading to species-rich secondary forests, which sustain commercially valuable native woody species.

For these reasons, the management of montane secondary forests is suggested as a more sustainable socioeconomic option. This alternative deserves our special attention as the management of these

successional forests appears to be a low-cost and high-benefit option, because they can grow without much human labor: after clearing and burning, less than a decade of grazing and subsequent abandonment, a healthy forest recovery process is possible. Through this process, two complementary goals are achieved: i) ecosystem recovery and restoration of key ecological functions are stimulated, and ii) a new, natural resource with a socioeconomically high potential value is created. Thus, montane secondary forests can principally be used for timber and fuelwood production, while, at the same time, their vegetation cover protects the fragile soils against erosion features and restores the area's hydrological function. Moreover, montane secondary forests may form corridors connecting isolated fragments of pristine forest - a must for the survival of many animal species. As montane secondary forests grow older and become more mature, their usefulness can be improved by favouring desirable native tree species through thinning and enrichment. In the long run they may reduce the pressure on the undisturbed mature forests still abounding in the neighbouring Amistad Biosphere Reserve. The active participation of local people is of utmost importance to the success of such an (initially experimental) initiative

## Envisioning Sustainable Alternatives

### The Principles of Ecological Economics: Views of Economists

#### Panelists

1. Joan Martínez-Allier: *The principles of ecological economics: the central importance of the distribution of income*
2. Faye Duchin: *The principles of ecological economics: a structural approach for building an empirical science*
3. Herman Daly: *Toward a macroeconomics of the environment*

Chair: Robert Costanza, *University of Maryland, United States*

#### The principles of ecological economics: the central importance of the distribution of income

Joan Martínez-Allier  
*Universidad Autónoma de España*  
Spain

Mainstream economics has always acknowledged that the pattern of prices and quantities transacted will depend on the distribution of income. Given a distribution of income, neoclassical economics attempted to explain the remunerations of the services of factors of production as a result of economic transactions themselves. In the 1960's there was a strong debate

started by Sraffa on the central importance of the distribution of income as between wages and profits in order to explain production prices. In the paper, building on this background, I shall analyze how the allocation of natural resources and environmental services to alternative uses will depend on distributional issues, not only among today's generation but also across generations.

#### The principles of ecological economics: a structural approach for building an empirical science

Faye Duchin  
*The New York University*  
United States

Herman Daly, with his "macroeconomics of the environment", has provided a defining theoretical foundation for Ecological Economics. I will suggest

that its limitation is in its acceptance of the dichotomy between a macroeconomics and a microeconomics (presumably a reformed general

equilibrium theory) and the failure to insist on the conceptual integration of theory with modeling and calculation, allowing the latter to take on lives of their own in the nebulous category of "applications".

A structural approach can integrate many big-picture (macro-level) and detailed (micro-level) phenomena while at the same time providing a unified basis for cumulative empirical studies of issues that this community deems important. The formulation is in terms of the inter-related stocks and flows of different categories of capital (incorporating the concerns of biophysical economists) and flows of goods and services and, where applicable, the

associated money costs and prices. The dynamics are based on the building up and drawing down of stocks and on technological and social change. The unit of analysis is not the individual firm and the individual consumer, but the sector and the household -- larger units with technological and social significance, respectively. Input-output or multi-sectoral economics, which has been vastly generalized by both economists and applied physical scientists (starting with Bruce Hannon in the 1970's among the latter) since its creation by Wassily Leontief almost 60 years ago, plays a central organizing role. "Issue-oriented" empirical applications will be cited.

### **Toward a macroeconomic of the environment**

**Herman Daly**  
*University of Maryland*  
United States

Limiting the physical size of the economy (human niche) to an optimal scale relative to the finite ecosystem is arguable the fundamental macroeconomic challenge for Ecological Economics. It involves limiting total consumption (population times per capita consumption). The question we must answer is whether consumption is the final

purpose of economic activity, as standard economics seems to say, or whether it is in Kenneth Boulding's phrase "the death of capital". We need to determine what understanding of consumption if appropriate for ecological economics and what policies regarding consumption follow from this conception.

## Envisioning Sustainable Alternatives

### Development and the Environmental Commons: Critical and "South" Perspectives

#### Panelists

1. Jack Ruitenbeek, *Valuation and distribution of ecological entitlements: Cameroon*
2. Dale Doré, *Institutional constraints to the sustainable management of natural resources in the communal areas of Zimbabwe*
3. Pablo Gutman, *Development countries and international environmental negotiations: the risks of poorly informed choices*
4. Kanchan Chopra, *Valuation and pricing of non-timber forest products: a study for the Raipur District of Manhya Pradesh (India)*
5. Jaap Arntzen, *Revaluation of rangeland use in Southern Africa from single towards multiple use*

**Chairs:** Martin O'Connor, *The University of Auckland, New Zealand*  
Andy Dragun, *La Trobe University, Australia*

#### Valuation and distribution of ecological entitlements: Cameroon

Jack Ruitenbeek  
*H. J. Ruitenbeek Consulting Limited*  
United States

The concept of economic and environmental security is explored in a broad sense as a series of necessary entitlements to forest resources. Traditional measures of inequality - such as the GINI coefficient or the Atkinson index of inequality which rely on measures of the distribution of cash income or wealth - are regarded as flawed to the extent that they do not adequately reflect the value and distribution of access to non-marketed goods and services. An "ecologically - adjusted" Atkinson-index is proposed as a more relevant measure of inequality and of economic and environmental security. To improve security, policies must attempt to improve the value of this index.

An empirical example is provided based on household survey data for 357 households in 24

villages in a rainforest zone of Cameroon. Analyses of data relating to forest use, incomes, and demographics provides insights into the distribution of ecological entitlements across various income groups and into the impacts of these entitlements on economic and environmental security (through measures related to population migration). The empirical analysis demonstrates a number of important conclusions: a) use of ecologically adjusted indices provide a more complete picture of inequality: inequality in the forest zone is less pervasive than traditional measures would have us believe, b) traditional forest uses contribute positively to reducing inequality and improving security; and c) income support programs targeted to conventional cash crops (cocoa and coffee) increase inequality and reduce security.



The analyses also demonstrate that population movement is a potentially useful indicator of environmental and economic security, an analysis of

migration, wealth and income patterns suggests that low population movement in this zone can be construed as an indicator of higher security.

### **Institutional constraints to the sustainable management of natural resources in the communal areas of Zimbabwe**

Dale Doré  
Harare  
India

The chiefly allocation of land and the imposition of political and development institutions in the communal areas has created a set of fractured local organizational structures, and overlapping boundaries and rights to natural resources. Open access to common resources under conditions of rapid

population growth, and the tactics employed by local leaders to gain territorial advantages, has led to the unsustainable use of natural resources. It is argued that resource management could be facilitated by institutional restructuring, boundary realignment, and the establishment of common property regimes.

### **Valuation and pricing of non-timber forest products: a study for the Raipur District of Manhya Pradesh (India)**

Kanchan Chopra  
*Institute of Economic Growth*  
India

Forests are traditionally viewed, from the world economy perspective, as suppliers of timber. But a number of other non-timber forest products (NTFPs) are perhaps more significant for economic welfare. These include ecological services such as nutrient, recycling, water cycling, micro-weather moderation, and genetic patrimony, and also food and materials obtained through forest agriculture and harvesting of food sources. The focus of this paper is the valuation and pricing of NTFPs, and the distinct

analytical and empirical issues arising in relation to each type of product and ecological situation. After a critical discussion of conventional economic valuation methods (market and social value, biases from income distribution, and so-called market imperfections, etc.), the paper addresses the question of valuation and management of NTFPs in some Indian forests, particularly with reference to non-instrumental values and biodiversity.

## **Revaluation of rangeland use in Southern Africa from single towards multiple use**

**Jaap Arntzen**  
*University of Botswana*  
Botswana

The paper has two objectives. The first one is to revalue views on rangeland degradation in Southern Africa. The second one aims to demonstrate the shortcomings of sectoral analyses, especially those confined to the livestock sector, and the need for a multisectoral analysis of the rangeland potential and utilization. To meet the objectives, the paper uses environmental-economics tools within the broader framework of sustainable rangeland management. Throughout the paper, empirical examples of Southern Africa will be used. Special attention will be paid to the role of government policies and instruments.

### **Rangeland degradation**

Traditional thoughts on rangeland degradation are rapidly changing. Until recently, rangeland degradation was universally assumed to be widespread in Southern Africa. Recent research, however, has shown that some of the signs traditionally associated with degradation do not necessarily represent a long-term degradation process, but rather the impacts of recurrent droughts. The latter often act as "natural" safety valves to prevent widespread rangeland degradation. Although this new paper argues that the sectoral approach taken (i.e. livestock industry only) is too limited from

an environmental-economic perspective. It bypasses many external impacts of the livestock sector, undervalues rangelands, and it pays insufficient attention to the long term aspects.

### **Multiple and Optimal rangeland Use**

In Southern Africa, rangelands serve a number of purposes such as a fodder for livestock and wildlife, wood for fuel and construction purposes, edible and medicinal plants etc. The vegetation cover also protects the soil and increases groundwater recharge.

With mounting resource scarcity, optimal resource use becomes crucial. In Southern Africa, following the improvement of borehole technology, the expansion of the human population and substantial government support for livestock, more rangelands are being used by cattle, and fewer land remains for wildlife. There are signs that the above have led to an overexpansion of the livestock industry, has damaged the environment, and has had limited benefits to the local population. In most countries, efforts have started to make better use of the wildlife resource in the form of game farming/ranching and community-based wildlife utilization schemes.

## **Ecosystems, Biodiversity and Development**

### **Natural Resource Accounts: National, Regional and Sectorial Applications**

#### **Panelists**

1. Knut Alfsen: *Natural resource accounting and analysis in Norway*
2. Marian de los Angeles, María Bennagen and Henry Peskin: *Managing pollution in the Philippines: insights from the Philippine environmental and natural resources accounting project (ENRAP)*
3. Glenn-Marie Lange: *Strategic planning for sustainable development in Indonesia: the role of natural resource accounting*

**Chair:** Jack Ruitenbeek, *H. J. Ruitenbeek Resources Consulting, Ltd.*, United States

#### **Natural resource accounting and analysis in Norway**

Knut Alfsen  
*Statistics Norway*  
Norway

The paper briefly outlines the content and structure of the Norwegian natural resource accounts as these have developed over the years. Initially, work on the natural resource accounts was motivated by a desire to improve the management of natural resources within a national context. Over time, it was gradually recognized that lack of systematically organized data is not the main obstacle to a satisfactory resource management in Norway. Therefore, more emphasis is now put on trying to integrate environmental and resource issues within the traditional economic planning tools, highlighting the linkages between economic development, natural resource use and environmental concerns. The integration secures consistency between economic analysis and analysis of important environmental and resource issues such as air pollution and energy use. In our view this provides better support for decision makers than the often suggested proposal of "correcting" GDP or other aggregates of the national accounts.

Examples of integrated environment-energy-economy models will be presented together with

some empirical applications of these models. It will be shown that environmental control policies directed at one economic sector can have important repercussions for the rest of the economy. Thus, in order to capture the total economic effect of a change in policy, a general economy wide model should be used. Tentative calculations of secondary benefits associated with climate policies are also presented.

Overall, the aim of the paper is to illustrate the importance of organizing the natural resource accounts in a manner that facilitates its usefulness for analytical purposes. This will enhance the probability that the linkages between economic, natural resource, and environmental issues are brought to the attention of the decision makers.

Quite often it turns out that one can show, even with a limited set of data, that proper management of natural resources and the environment makes economic sense.

## **Managing pollution in the Philippines: insights from the Philippine environmental and natural resources accounting project (ENRAP)**

Marian de los Angeles, Maria Bennagen and Henry Peskin  
*ENRAP*  
Philippines

The paper draws from the pollution studies of the Philippines environmental and natural resources accounting project which implemented a comprehensive approach of full accounting with valuation developed by Henry Peskin.

The results show that the non-industrial sectors, household and government, are as important as the industrial users of the environment. These sectors substantially generate water pollutants (in terms of biochemical oxygen demand and suspended solids) and air emissions (particulate matter, carbon monoxide, and volatile organic compounds). Power generation is the most important source of NOx and Sox gases. Reducing pollution from these sources significantly improves water and air quality.

Water pollution control cost is considerably higher than the cost of reducing air pollution. In the aggregate, government will considerably improve water quality by focusing its public investments in sewerage systems and in restoring vegetative cover to deforested, sloping land. Air pollution control, on

the other hand, could be undertaken by the generating sectors themselves, as a response to full cost pricing of electricity, fuelwood, and vehicular use.

The costs of pollution reduction, in the aggregate, exceed the benefits of pollution reduction. On the whole, untargeted, large-scale cleanup using late 1980s technologies, is not desirable and careful prioritization towards specific activities and areas where incremental benefits exceed incremental costs is necessary. In terms of efficiency, reduction of pollution should be aimed at the forestry and mining sectors, through investments that improve the vegetative cover of sloping land and reducing mine tailings disposal downstream. In the long term, technological advances that reduce residuals generation should lower the cost of pollution control. This is imperative since achieving the targets for NICHood would generate substantial residuals that are costly to control using end-of-pipe pollution reduction technologies.

## **Strategic planning for sustainable development in Indonesia: the role of natural resource accounting**

Glenn-Marie Lange  
*New York University*  
United States

Much has been written about Natural Resource Accounts (NRA) from a conceptual point of view, but relatively few countries have compiled NRA on a regular basis and even never have used them for policy analysis. The purpose of this paper is to provide a concrete example of how NRA can be used for policy analysis at the national and sectorial levels,

based on work conducted by the author in Indonesia.

The paper will address the following major areas:

- Design of the NRA framework and compilation of the data. To ensure that NRA will be useful to decision-makers, it is necessary to identify for

the outset the environmental problems and natural resource strategies NRA will be used to address. In the Indonesian example, the primary focus is on food self-sufficiency over the next 30 years (land and water) and the development of forests for a domestic paper industry (forest land, management of natural and plantation forests). A secondary focus concerns the adequacy of current water pollution standards and the potential need for air pollution standards. The paper also addresses how different parts of NRA are compiled -- these data differ from data about the economy and may require different methods for estimation.

- Design of an ecological-economic model for policy analysis. The paper discusses the kinds of models appropriate for use with NRA, how to integrate NRA with the model, and how to formulate alternative scenarios about future development strategies which, when implemented in the model, will estimate alternative NRA for the future. In the Indonesian example, a dynamic input-output model was used.
- Interpretation of NRA. The NRA initially provide data in physical terms. Methods to interpret these data in policy terms include the use of physical standards and monetary valuation.

## **Ecosystems, Biodiversity and Development**

### **Population and the Environment: Rethinking the "Consensus"**

#### **Panelists**

1. Patricia Hynes: *Population and the environment*
2. Nalini Visvanathan: *National security, environment and population*
3. Michael Brower: *Population complications: understanding the population-environment debate*
4. Fatima Vianna Mello: *Challenging the conventional population/environment paradigm: an analysis of the Brazilian Amazon*

**Chair:** Betsy Hartmann, *Hampshire College, United States*

#### **Population and the environment**

Patricia Hynes

*Tufts University and Institute on Women and Technology  
United States*

The environmental impact formula  $I=PAT$ , known as the Ehrlich equation, has framed the population-environment debate over the past two decades for advocates and critics alike. As the debate becomes more nuanced, the P of  $I=PAT$  increasingly refers to the one-fifth of humanity in Africa, Latin America, and South Asia who are absolutely poor and have the highest fertility rates,

while the A and T are associated with the consumption and technology of the wealthiest and most industrialized fifth of the world's population. This presentation will reformulate  $I=PAT$  to include key structural factors that have been omitted, such as the impact of the military on the environment, and will analyze male and female agency in each factor of the equation.

#### **National security, environment and population**

Nalini Visvanathan

*School for International Training  
United States*

There is a growing trend among policy analysis, environmentalists and journalists to cite the environment as the national security issue of the nineties. What are the implications of this trend?

What are the precedents that facilitate an understanding of this linkage of a global issue with U.S. national security? What are the strategies deployed to position and reinforce this linkage in

public discourse? How is national security conceptualized? To answer these questions the paper will survey the use of the concept of national security in policy formulation and critically evaluate how population came to be regarded as a national security issue in the sixties and seventies. It will then analyze the current characterization of the environment to demonstrate that population growth, specifically in the South, is the target of those who

promote this perspective. At the same time it will assess the consumption needs of the U.S. population, especially the military and the corporate sector, which are often ignored or hidden in public discourse. Finally, through cases and incidents, it will delineate and exemplify the various strategies used to keep population growth in the South in the forefront of public debate and discourse on environmental conservation.

### Population complications: understanding the population-environment debate

Michael Brower  
*Union of Concerned Scientists*  
United States

The centuries-old debate over population growth and its impacts on human development and the environment has been characterized by extreme opposing viewpoints. Some have argued that the population "explosion" is the most serious threat to humanity's future as well as a principal underlying cause of poverty, hunger, deforestation, and other problems. Others have argued, however, that there is no proven link between population growth, poverty, and environmental degradation, and that having more people on the planet may in fact be beneficial in the long run, at least in part because it will make greater intellectual resources available for solving problems.

As in most debates over complicated subjects such as this one, the truth lies somewhere between these two extremes. There is little doubt that population growth as well as migration and other aspects of demographic change can place increased

stress on the environment and natural resources in a number of ways, perhaps most clearly through the link between population and food production. It is equally clear, however, that this relationship is only one aspect of the complex and interrelated problems posed by human development, and from the perspective of designing policies to cope with ecological destruction, it may not be the most important one.

Will give an overview of the links between population growth and the environment, with particular emphasis on available scientific evidence and the results of field research to date. It will discuss the attractions and shortcomings of various models, including the famous I=PAT, and will attempt to put population growth in the context of other factors contributing to environmental degradation. Some policy implications will be discussed.

## **Challenging the conventional population/environment paradigm: an analysis of the Brazilian Amazon**

**Fatima Vianna Mello**  
*FASE*  
**Brazil**

This presentation aims at challenging the assumptions made by a significant portion of mainstream environmental organizations, which link increasing poverty and environmental degradation to population size and growth in Southern countries. Despite the fact that these assumptions are presented as statistical and technical absolute truths, they are based on specific political, macroeconomic and security interests. By defining lowering population growth as one of the most important measures to achieve sustainable development, these assumptions avoid the crucial issue of how power is structured within and between countries.

The presentation will demonstrate that the relationships between population and the

environment are defined by forms of social, economic and political organization, which determine for what purposes natural resources are used -- to meet people's basic needs or to serve national and transnational economic interests by displacing communities. This approach will be illustrated with a case study of the social, economic and environmental dynamics of the Brazilian Amazon region, where small peasants, rubber tappers, fishermen and indigenous peoples struggle for survival. This struggle includes defense of the natural resource base, which is being threatened by the invasion of big "development" projects such as hydroelectric dams and roads funded by multilateral institutions.



## Ecosystems, Biodiversity and Development

### What do Communities Need from Ecological Economics?

#### Panelists

1. Rachel Schurman and Michael Goldman:
2. Enrique Leff:
3. Mary Mellor:
4. Charles Müller: *Urbanization, poverty and the environment in Brazil: how not to tackle a difficult problem?*
5. Katherine and John Peet: *Global learning for sustainability - with people's wisdom*
6. Lori Ann Thrupp: *Social justice as a key element of sustainable development*

Chair: Martin O'Connor, *The University of Auckland, New Zealand*

#### Urbanization, poverty and the environment in Brazil: How not to tackle a difficult problem?

Charles Müller  
*Universidade de Brasilia*  
Brazil

The concept of sustainability requires that current efforts to meet the needs of the present do not compromise the ability of future generations to meet their own needs. Moreover, it emphasizes the need to eliminate extreme poverty and to reduce inequality, within and between nations. Neoclassical environmental economics is essentially geared to the well-being of today's rich countries, accordingly, its instruments of evaluation tend to be inadequate for treating problems of poverty and social inequality in developing countries. The object of the proposed paper is to examine an instance of the use of neoclassical tools to evaluate the economic viability of investments in sanitation in Brazil's poor urban agglomerations.

Brazil presents a classical instance of urban environmental problems stemming from a social organization that simultaneously generated conventionally measured growth, as well as high and increasing social inequality. In the process, the

country experienced rapid urbanization and an increasing concentration of the poor in large cities, where they face acute deficiencies of basic services, among which, sanitation. The proposed paper centers on this aspect of Brazil's development. It will examine the evolution and present state deficiencies are large, and that they strongly affect the urban poor. The study will examine the evolution of investments in sanitation in metropolitan centers, where the quick pace of urbanization makes it particularly difficult to eliminate the sanitation deficit.

There has not been a consistent effort to tackle the problem. Moreover, neoclassical economics have been used to argue against investments in sanitation for the urban poor. This case study of evaluated in the proposed paper. It will end by arguing for the need to provide practical tools in ecological economics, that are flexible and innovative, to help guide efforts at tackling the dimension of poverty in sustainability.

## **Global learning for sustainability - with people's wisdom**

**Katherine and John Peet**  
*University of Canterbury*  
New Zealand

In this paper we consider some strategies for education about sustainability. Our interest is in adult education, however, not the education of young people. The main reason is that, if we wish to change the direction in which society is going we need to start with the principal decision-makers - adults - in the expectation that schools will then be able to respond.

Even with this reduction in scope, it is still a large issue. For example, who are we trying to "educate" about sustainability? Is it the masses in the industrialized north, who consume a disproportionately large quantity of the world's resources, or those of the south, where rainforests are being cut and deserts created? Is it the elite of both, or the masses over whom the elite hold financial, political or military power? Is it all of these?

Whatever the answer to our questions, different approaches must be used for different groups.

There is a context for each, to which the adult education strategy must respond.

Here we take a somewhat simplified approach, in that we describe the topic in terms of two adult education models, the "consensus" and "conflict" paradigms. They differ fundamentally in their views of the structure of society, and in their notions of inequality. While it is tempting to do so, we do not suggest that they simply reflect north and south, right or left. As a generalisation, however, we believe that there is evidence that the poor and vulnerable are already living more sustainable lifestyles than the rich and powerful. Given the opportunity to do so they would live even more sustainably. The opportunity to do so is closely involved with the need to give them the confidence to see themselves as in fact the leaders, as we move towards the 21st century.

## **Social justice as a key element of sustainable development**

**Lori Ann Thrupp**  
United States

Social equity and justice are increasingly important concerns in agendas concerning environment and development. Numerous groups and communities, in both the North and the South, are striving to overcome injustices in environmental and health conditions and working to surmount disparities in access and use of resources. These struggles concern hazardous waste siting/dumping, exposure to toxic chemicals, occupational health problems, and unequal rights to resources. The dilemmas are manifested in relation to race, class, gender and marginalized ethnic groups. The main purpose of this paper is to contribute to the

understanding of the linkages between social injustices and environmental degradation, and conversely, to elucidate the role of justice in relation to sustainable development in a global context. To do this, central dimensions of environmental injustice are analyzed in relation to specific case studies. The analysis is situated within the broader political ecological context; it clarifies power relations between disparate groups that affect environmental and social conditions. The paper also identifies policy implications and effective strategies to uphold justice as a vital part of sustainable development.

## Ecosystems, Biodiversity and Development

### Water Resources and Economic Valuation

#### Panelists

1. Thomas Sterner and Mildford Aguilar: *Drinking water management, marginal cost vs. willingness to pay: a case of study rural areas in Costa Rica*
2. Andrew G. Keeler: *Ecosystem health indicators and economic models of water pollution*
3. Heung-Dong Lee: *Economic evaluation on the alternative uses of Korean coastal wetland: preservation and development*
4. F.N. Scatena, Steven Doherty and H.T. Odum: *The value of water in Puerto Rican Forest*
5. Carlos Quesada: *The role of "La Tigra" National Park on the social and economic aspects of water supply for Tegucigalpa City*
6. Federico Aguilera Klink: *Water management, environment and institutions: the water as an ecological asset*

Chair: Carlos Quesada, Universidad de Costa Rica, Costa Rica

#### Drinking water management, marginal cost vs. willingness to pay: a case study of rural areas in Costa Rica

Thomas Sterner and Mildford Aguilar  
Gothenburg University  
Sweden

The paper analyses the practical management of drinking water in rural areas in Costa Rica.

Water is a common property resource which is extremely important for all living on this planet. Population increasing follow an increment in all economic activity, which is reflected in the increasing of water demand, pollution and scarcity of resources.

Drinking water has been considered as a free access resource, strongly subsidised from governments. This has derived that water enterprise in the world wide face serious economical deficit to cover a minimal service level.

In Costa Rica the water enterprise applied the collective participation in rural areas, to diminish

costs and improve the service. Actually there are about 1,000 water committees (CAAR) in Costa Rica, the CAAR are autonomous with the adviser from the Central water enterprise.

This kind of organization is an excellent tool to increase participation of household in the administration and control of the water services.

The necessity to improve the efficiency and knowledge about the actors in this market is one important step to reach a sustainable use of water resources. The economic variables in the supply- and demandside are not used in the practice. Therefore the knowledge of long run marginal cost, willingness to pay for water service is an urgent necessity to

develop a pricessystem to insure the sustainable development of water resources.

This paper will present the cost study and the empiric result of a survey in order to know the willingness to pay and participation level in the committee for the household in two different regions in Costa Rica. These results will be used to develop a pricessystem for the rural drinkingwater system in Costa Rica.

This study is a practical study, in which we

applied the contingent valuation and marginal cost approach to develop the tariff system in the rural areas.

In order to develop a long run marginal cost, the experience in the energysector will be used.

An econometric model for WTP will be developed in order to have information of the sensibility of WTP respect to several variables (income, prices, participation, etc.)

### **Ecosystem health indicators and economic models of water pollution**

**Andrew G. Keeler**  
*University of Georgia*  
United States

Economic models and studies of water pollution from agriculture have focused on limiting sediment, nutrient, and chemical loadings leaving farm borders. Ecological scientists have been concerned with the watershed-wide effects of this pollution on the ability of the aquatic environment to support indigenous flora and fauna. Toward this end they have developed macroinvertebrates, in an ecosystem relative to a similar unpolluted area. In this paper we examine the consequences of specifying economic models of environmental

regulation and farmer behavior in terms of these ecosystem. This methodology results in an explicit recognition of the imprecision of current modeling approaches and offers some useful suggestions for the kind of regulatory contracts that can be developed between regulators and farmers under the U.S. Clean Water Act and Coastal Zone Act. We apply this concept in a study of a single Georgia watershed using crop simulators and report the implications for policy design.

### **Economic evaluation on the alternative uses of Korean coastal wetland: preservation and development**

**Heung-Dong Lee**  
*Marine Policy Center, KORDI*  
Korea

Coastal wetlands in Korea provide important and valuable goods and services to the public. There are some conflicts in their usage between protectionists and developers because of heavy demand for them. We are experiencing a lot of reclamation along the

west coast of Korean peninsula for agricultural or manufacturing purposes.

The purpose of the paper is to value these services and goods for each alternative for utilizing the limited national resources optimally. The

valuation of resources for the optimal wetland management is complicated with the difficulty of comparing different management options such as preservation of wetland and its conversion for an agricultural or industrial uses. Then, it tries to propose a policy framework for coastal wetlands management and for the enhancement of the public welfare in economic view.

The paper is applied to the case of the west coast where the reclamation program is very active. The focus will be upon the scientific information and data suitable for resource valuation efforts. Valuation techniques include market theory for marketable goods and services and contingent valuation method for non-marketable ones.

Next it will describe the rapid evolution of national program on coastal wetland utilization. The benefit from their conversion will be compared with the benefit from the preservation of wetlands. Cost-benefit analysis is used for quantification on all important beneficial and detrimental factors of

alternative options in monetary term.

Comparative study examines to evaluate comparative advantages between wetland preservation and its conversion. This approach will indicate which alternative is best for the allocation of marine resources.

The paper is organized as follows. Section 1 introduces the purpose of the paper and general descriptions on wetland. Section 2 provides geographical characteristics of coastal wetland in Korea and the usage of current status and future prospects. Section 3 uses scientific and socio-economic data to analyze economic valuation of marine resources as well as alternative benefit from wetland conversion. Economic theories and tools for valuation of goods and services in both alternatives are applied. Section 4 compare both alternatives by using of the benefit-cost analysis. Finally, section 5 give summary and concluding remarks to reduce the rate of coastal wetland losses based on an economic value framework.

## The value of water in a Puerto Rican Forest

F. N. Scatena, Steven Doherty and H. T. Odum  
*USDA Forest Service, International Institute of Tropical Forestry*  
United States

The Luquillo Experimental Forest (LEF) in Puerto Rico is an 11,000 ha forest managed for production, recreation, education and research. In addition to these direct multiple-uses, the forest supports by-product services not recognized in monetary accounts, including carbon sequestration, water supply and habitat for biodiversity. We completed an energy systems analysis of Puerto Rico and LEF to value contributions from the forest, its ecosystem processes and stored natural capital relative to other activities on the island. A relationship was made between total, island-wide resource-use, including environmental production, and the gross economic product of Puerto Rico. With this index the contribution of any sector, including the forest, could be valued relative to the economic activity generated

by Puerto Rico's combined ecologic-economic system.

A ratio of invested, economically derived resources to environmental production of less than 1 indicates that LEF contributes more to the economy of Puerto Rico than is invested. This is especially beneficial to an island largely dependent on external trade and where the regional investment ratio for production sectors is more than 40 to 1. Further, in addition to direct services from forest processes, LEF is shown to attract almost 3 times the resources to the island, through tourism and research activities, than is invested from the economy.

Each of 4 lifezones present in LEF were separately evaluated for net production and water

supply. Lowland subtropical wet forests, with the greatest production and above ground biomass storage had the greatest annual contributions (\$940/ha/yr production and \$57,200/ha stored in biomass). The lower montane elfin rainforest had the greatest annual per hectare contribution from water runoff (\$3760/ha/yr), with 96% of its precipitation runoff (18hm<sup>3</sup>/yr) to lower elevation systems. These values help us recognize the role of energy

transformations and convergence from higher altitude forests.

For the entire forest, by-product services supporting multiple-users were valued at more than \$3000/ha/yr; an annual contribution of 34 million dollars -- 7 times the annual operating budget of LEF. Our analysis also indicates that the value of stored forest biomass, representing past environmental work, is on average 14 times greater than current land prices.

### **Water management, environment and institutions: the water as an ecosocial asset**

Federico Aguilera Klink  
*Universidad de La Laguna*  
Spain

Most economists consider water just as a production factor necessary for economic activities. From this standpoint, water management become a monetary-technical problem aimed to calculate the supposed optimal water prices for every economic activity in order to determine which activities make the more efficient use (in monetary terms) of the resource.

In the first part of this paper I reasonably argue in favor of a reconceptualization of water as an ecosocial asset, that is to say, as an economic,

ecologic and social heritage. In other words, water belongs to the society, it allows a specific way of life, it is also a fundamental part of the national wealth -although it does not even appears in National Accounts- and assures a set of environmental functions which permit life to go on.

In the second part of the paper I review the significance of the institutional framework for the understanding of the notions related to water management.

## **Ecosystems, Biodiversity and Development**

### **Agro-Ecosystems and Sustainability**

#### **Panelists**

1. Peter May, Celso Vegro, José Alexandre de Souza Meneses: *Export policies, agroindustries and the environment in Brazil: the case of coffee and cocoa*
2. Bernardo Aguilar: *Banana production in light of sustainable development in Costa Rica: eco-friendly Banana?*
3. Adriano Ciani and Antonio Boggia: *The European Communities agro-environmental program: a challenge for sustainable development towards XXI century*
4. Ronald Polanco Ribeiro: *Policy studies for the extractive sector: Brazil nut case study*
5. Sabine Müller: *A framework for evaluation the sustainability of activities in the agricultural sector*

**Chair:** Mehmet Arda, *UNCTAD*, Switzerland

#### **Export policies, agroindustries and the environment in Brazil the case of coffee and cocoa**

Peter May, Celso Vegro, José A. de Souza  
*Federal Rural University of Rio de Janeiro*  
Brazil

This study describes environmental problems in coffee and cocoa agro-industries in Brazil, as they relate to economic policies, trade and macroeconomic conditions. Producers of these crops have suffered from recent declines in international market prices. Their vulnerability has been particularly intense due to domestic institutional reform and trade liberalization. Collapse of economic clauses in international commodity agreements has forced marginal farmers to uprooting these crops and replace them with pastures.

The environmental effects of coffee and cocoa production are felt most severely by rural workers due to pesticide abuse and employment insecurity. As a further effect of land use conversion and loss of product competitiveness, the Atlantic Forest biome is

falling to the ax as cocoa agroforestry systems suffer their demise.

Consumer demand also imposes environmental costs. Quality restrictions affected by consumer preferences have impelled growers to apply heavy and preventive doses of pesticides to guarantee flawless bean appearance. Policy efforts should aim to facilitate adoption of integrated pest management or seek ways to overcome consumer quality demands e.g., marketing of organic and cooperatively grown products as a sustainable strategy. Cradle-to-grave approaches should consider better means to dispose of residuals in soluble coffee manufacture, and of materials used in vacuum packaging of ground coffee for export. Alternative policies under active consideration as mechanisms to finance commodity

area include: green labelling, debt-for-nature swaps, precautionary environmental damage insurance and

emissions charges or taxes.

## **Banana production in light of sustainable development in Costa Rica: eco-friendly Banana?**

**Bernardo Aguilar**  
*The School for Field Studies*  
Costa Rica

Banana production is the main source of export income in many developing countries. It is also one of several foreign investment channels and a big source of employment in Latin American agriculture. Nevertheless, it is responsible for a big share of the deterioration in the base of the natural capital of the areas that are cultivated. In Costa Rica, specifically, this activity exerts a strong pressure on the agricultural colonization frontiers and on the protected areas that are beside them. In addition, resource degradation *in situ* (soils, water, forested areas, etc.) is significant.

The Rainforest Alliance and Ambio Foundation have promoted the Eco-Friendly Banana Program that gives the "ECO-OK" seal to the banana producers that follow guidelines to minimize the environmental impact of their plantations. This seal allows consumers to recognize these alternative management practices and encourages the market to

give incentives through special prices.

However, in spite of representing an advance, this program is not directed towards significant change. With the help of assignment, distribution, and scale parameters, and using the case study method, this study has concluded that the Eco-Friendly Banana Program does not promote the structural changes that are needed to turn banana production into sustainable agriculture. Fundamental problems which are not considered include the maintenance of the natural and human capital base, unequal resource distribution, and the distortions caused by the monopoly practices of multinational companies. Although they do not have to consider these problems, the consumer is led astray. In addition, this approach encourages the utilization of palliatives that do nothing to solve some of the main problems that this production is responsible for.

## **The European Communities agro-environmental program: a challenge for sustainable development towards XXI century**

**Adriano Ciani and Antonio Boggia**  
*University of Perugia*  
Italy

The paper originated from some research works on biological agriculture, environmental costing and accounting, environmentally sound management of land projects and plans. After an analytic description

of the EEC Reg. 2078/92, concerning the agro-environmental program, the authors carry out a comparative analysis between the situation before and after the application of the program, on a sample



of EEC farms. In particular, the comparison is founded on the new economic paradigms of N. Georgescu-Roegen, and on the energy balance. Furthermore, the authors go through the problem of the monetary valuation of the environmental aspects, which need to be incorporated in a new paradigm of the production cost. They do this presenting some cases from the sample, in which the traditional

balance sheet is compared with a balance sheet containing the consideration of environmental aspects in monetary terms. These measuring sustainable development. The conclusion is a final synthesis on the effects of the EEC Agro-environmental program which, based on the LISA (Low Input Sustainable Agriculture) strategy, seems to be a coherent challenge for sustainable development towards XXI Century.

### **Policy studies for the extractive sector: Brazil nut case study**

Ronald Polanco Ribeiro  
*Xapuri Agroextractive Cooperative*  
Brazil

Extractivism, principally of Brazil Nuts, plays a substantial role in the income composition of extractivist households in the State of Acre. Although socially important for the regional population, extractivism has not received the attention of statistical or economic analysis and, from the point of view of State revenues, represent little in relation to intergovernmental transfers. There is also little known about the multiplying role of this activity on the local economy (additional employment generated, commercial activities that revolve around extractivist activity, etc.)

An important factor, nevertheless, is that the processing of Brazil Nut, both centralized and principally in a decentralized mode, in the short run, can significantly improve the incomes of products and \_\_\_\_\_ a process of \_\_\_\_\_ of benefits for the state economy.

In the medium and long-term, on the other hand, reflection indicates that the state extractivist economy should be fortified, seeking to support proposals for implantation of agroforestry systems and seeking technological and economic policy alternatives within the objectives of sustainable development.

This study has as its objective to a more detailed economic analysis of this sector within its social context, pointing toward the necessity to make relevant public policies compatible with the concept of sustainability, rational utilization of resources and combating the depredation of the environment. Within this objective, specific medium and short-term proposals will be evaluated, as alternatives for development, leading to economic policies for non-timber forest products.

## **A framework for evaluating the sustainability of activities in the agricultural sector**

Sabine Müller

*Deutsche Gesellschaft für Technische Zusammenarbeit GmbH*  
Germany

Sustainability and sustainable development are a declared goal in political declarations, in the elaboration of new laws, in the statutes of institutions, in agricultural research, as well as in financial and technical cooperation. But, there is less consensus regarding what is exactly understood as "sustainability" and, on what scale sustainability can be measured. Without criteria, or indicators, that facilitate a qualitative and a quantitative assessment of the performance of the system regarding this goal, it is difficult to formulate and achieve activities that will lead to it. The present paper attempts to contribute to the on-going discussion about indicators and presents a preliminary framework for their definition in the agricultural sector.

After a short discussion of the prevailing concepts of sustainability in agriculture and the indicators or approaches actually being used to measure its performance, a methodological approach for the definition of indicators is proposed. Indicators have to be defined according to the specific system or the situation to be analyzed, and must also

consider the different aggregation levels. In order to compare different systems, the corresponding indicators should be determined in a logical and repeatable process, where the criteria used for the selection of the indicators are to be explained and justified.

Agroecosystems are considered to be the appropriate research unit, and sustainability is to be analyzed regarding quantity and quality of the resources and the performance of the system. Therefore, the three dimensions of sustainability (ecological, economic and social) have to be addressed, and possible trade-offs between them have to be addressed, and account. The selection process starts with the different categories of analysis, their respective elements and the significant characteristics of the elements which are related to the main qualities of the sustainability of a certain system - descriptors of sustainability. Thus, indicators measure the change of the descriptor. If the system is sustainable, this change is supposed to be small or positive.

## **Ecosystems, Biodiversity and Development**

### **Sustainable Development & Structural Change in Benin, Butan, Costa Rica and The Netherlands**

#### **Panelists**

1. Peter Lammers:
2. H. Deddehouanou:
3. V.J. Mama:
4. Sanders M. De Bruyn: *Ecological restructuring in industrial economies: some general remarks and a case-study of emissions from fuel combustion in The Netherlands*
4. Marco Antonio González:
5. J.Bouwhuis:

**Chair:** Johannes Opschoor, *Free University, The Netherlands*

## **Ecosystems, Biodiversity and Development**

### **Environment Related Issues in the African Context**

#### **Panelists**

1. Mohammed A. Jama: *Energy consumption patterns of rural households in Kenya*
2. Timothy Lynam, B.M.C. Campbell and S.J. Vermeulen: *Contingent valuation of multipurpose tree resources in the smallholder farming sector, Zimbabwe*
3. Collins Ayoo: *Sustainable exploitation of Lake Victoria fisheries*
4. M.M. Bakane-Tuone: *The economic demographic interactions in agricultural production in Lesotho*
5. Pierre Montagne, Alain Bertrand, Didier Babin: *Rural markets of wood energy in Niger subsidiarity, planning, and development for sustainable development*
6. Martine Antona, F. Bousquet, J. Weber: *Interactions between ecological dynamics and social dynamics*

**Chair:** Karl-Goran Maler, *The Beijer Institute*, Sweden

### **Energy consumption patterns of rural households in Kenya**

Mohammed A. Jama  
*University of Nairobi*  
Nairobi

Accelerated deforestation and scarcity of fuelwood have, in recent years, created a need for governments of developing nations to find policy alternative that reduce demand for fuelwood and thereby reduce pressure on forests.

This study sought to examine energy consumption patterns in a cross-section of rural households in Kenya and to analyze how these use patterns relate to socio-economic, demographic, institutional and energy market factors. The models specified was demand for fuelwood. A probit analysis was utilized to determine the conditional probability of fuelwood consumption and a least squares regression to determine quantity consumed.

Indifference curve theory was used to show fuel choices by different income groups. High income

households continue using a small amount of fuelwood because of unique attributes. The results for low and middle income households indicate that fuelwood use per households increased with more income, but among high income household, fuelwood use declines with increase in income.

The research indicates that household incomes, family size, improved ceramic stoves, lack of formal education are the most influential variables on consumption of fuelwood. The quantities of fuelwood are not very responsive to changes in income. Aggregate energy is income inelastic and a "normal" good while wood fuel and kerosene are "inferior" products.

## Contingent valuation of multipurpose tree resources in the smallholder farming sector

Timothy Lynam, B.M.C. Campbell and S.J. Vermeulen  
*Multispecies Animal Production Systems Project*  
Zimbabwe

An indirect contingent valuation method was used to determine the value of tree resources to smallholder farmers in three areas of Zimbabwe. Categories of goods and services provided by trees to smallholder households were ranked by household heads and then 50 points were distributed among these categories and two "anchors" to indicate the relative value of each category and anchor. The monetary value of one anchor was derived using direct questioning (WTP and WTA) and dichotomous choice questions. The values of all other categories (and the remaining anchor) were then derived in terms of units of anchor equivalents or their value relative to one unit of the anchor. Tests of the validity of the results were conducted and indicated that the survey results were valid reflections of the values of smallholder farmers for the tree resources to which they have access.

Farmers valued direct inputs to the household (fuel and materials) most, then inputs to other production activities (crop and animal production, ecological services as well as cash income) and lastly shade, health and social services. The value of tree resources could be equivalent to between 3 and 50 percent of annual household incomes. The values of farmers obtained in the survey reflect the relative scarcity of tree resources with total tree resource values being higher in low tree cover areas than in high tree cover areas. The added benefits derived from moving from a low tree cover to a high cover situation, in terms of *improved* access to resources appear to be about Z\$228 for materials, Z\$173 for fuel, Z\$122 for crop inputs, Z\$110 for ecological services and Z\$91 for animal feed.

## Sustainable exploitation of Lake Victoria fisheries

Collins Ayoo  
*Maseno University College*  
Kenya

Lake Victoria is Africa's largest freshwater lake commonly shared by the three East African states of Kenya, Uganda and Tanzania. It possesses considerable fisheries potential and in Kenya it is the major source of fish with lesser contributions coming from other inland lakes and rivers. It is the policy of the Kenyan Government to increase the lake's fish production through measures such as provision of improved equipment, strengthening fishing cooperatives, improving the processing, storing and marketing of fish and the provision of the necessary infrastructure. The expectation is that such measures would greatly increase the supply of cheap

high quality animal protein, create employment opportunities for the rapidly increasing population due to the labor intensive character of the fishing activity, and generate income to the numerous small scale fishermen and fish traders and thus contribute towards the alleviation of poverty.

But, serious concerns have now emerged regarding the sustainability of the current fish harvesting practices. The dominant view is that the present practices are not sustainable as evidenced by declines in output, general reduction in the size of

fish caught and loss of biodiversity. Overfishing is being held to be largely responsible for this trend.

This paper proposes to examine these questions in detail. Empirical data will be used to determine the maximum sustainable yield which will then be

compared to the catch levels. Judgement will then be made as to whether or not there is overfishing in Lake Victoria. Some policy measures for ensuring that the fisheries are sustainably exploited will then be suggested.

## The economic demographic interactions in agricultural production in Lesotho

M. M. Bakane-Tuoane  
*University of Fort Hare*  
Lesotho

The continued rapid, alarming and unprecedented rates of population growth in many parts of the less developing countries (LDC's) is the concern of most governments. The failure of most family planning campaigns renders the topic of the value and desirability of children a priority for African governments. It is empirically evident in this regard that the optimum level of children required by the households is different from that of the society.

The link between overpopulation and economic development has been studied and well documented in the literature. The impact of population growth on environment is the concern of governments and has been researched and studied by many scholars in different disciplines in recent years.

The environment policy in Lesotho dates back to the colonial era. Soil conservation methods and livestock management have been entrenched in the agricultural policy even after independence. Management of population growth however, has not been included as an integrated part of the environmental policy.

The major economic activity for the majority of the population is substance farming. this involves

both crop and livestock production. In crop farming there are several activities which involve an extensive use of labor including child labor.

The objective of the study is to examine the interaction between crop production and fertility and hence population growth in Lesotho. It is hoped that the results from this study will have a positive impact in the formulation of the Population Policy in Lesotho.

A sample of 300 households was selected from the low lands zone of Lesotho where crop production is concentrated.

Two models estimated were: 1. the household crop production function, and 2. the fertility function.

The results from these regressions show a clear correlation between household crop production and household fertility. From these results, it is concluded therefore that population policy that concentrates only the distribution of contraceptives is doomed to fail. More effort should be devoted on factors that will substitute for a high demand for children in the rural households.

## **Rural markets of wood energy in Niger subsidiarity, planning and democracy for sustainable development**

**Pierre Montagne, Alain Bertrand, Didier Babin**  
*CIRAD - GREEN*  
France

The challenge is to answer to the urban Nigerian domestic energy needs of fuelwood resource in the prospective of sustainable development. This task is hindered by the disorder of the lands and resources \_\_\_\_\_ due to i) colonial and post-colonial times, ii) recent dry periods in Sahel, iii) the strained relationship that exists between forestry administrators and locals. Therefore the aim is to came up with a global strategy designed to i) preserve the biodiversity of the environment, ii) ensure a sustainable fuelwood production, iii) a fair distribution of benefits between the producers and transporters/distributors. The common resources decentralized management is experimented after failure of the plantation policy and of the management by forestry cooperative. Now, the "Niger Domestic Energy Strategy" is based on territory planning and local self-management

(according to the subsidiarity principle). It is involved dialectic relationship with democratic principle. This rural markets system for fuelwood is a common resource decentralized tool. Some village forests, created at the initiative of both the State and the rural communities, are currently harvested by and for the villages. This is a complex and diversified institution which is socially legitimate. Whereby the relationship among forest users are not neglected in order to reinforce the local negotiation frame. This work emphasizes on how the appropriate patterns research (human groups and resources interactions) and the decision process could be a framework towards understanding conflicting situations of renewable natural resources. It also provides a framework for ecological, economical and sociological evaluation without hypothesis on individual and collective behavior.

## **Interactions between ecological dynamics and social dynamics**

**M. Antona, F. Bousquet and J. Weber**  
*CIRAD - GREEN*  
France

With the demographic growth of this end of century, the sustainable use of renewable resources became a major field of scientific research. There are many acceptance of the sustainability concept. One may focus either on the biodiversity preservation, or on the preservation of the uses, or on the conditions to create and maintain economic growth. So, the management of renewable resources is often conducted either from an ecological point of view, or form a social point of view, or from an economical point of view. However, none of these objectives

can be separately achieved. In each case, the main problem is to understand the interactions between ecological dynamics and social dynamics. Different uses rules or access rules to the resources may lead to different behavior of the whole men resources system.

Modelling is considered as an efficient tool to explore the ecosystems dynamics under various hypothesis. During the last twenty years, bioeconomics models have been developed to assist

the management of renewable resources. These models usually consider the exploited species but not the ecosystem as a whole. Conversely, the behavior of the society is stated as homogeneous.

In this paper, we present a model which simulates a multispecific fish community dynamics and the individual decision-making process. The model is based on Distributed Artificial Intelligence principles also called multi-agents simulations. Multi-agent simulations are used to represent complex situations in which agents (fisherman, fish...) have

different behaviors and to analyze the global situation as emergent structure of the interactions.

In order to improve our understanding of the viability of the man resources interaction under the demographic growth hypothesis, we present some experiments of different uses and rules of access to the resources (open access, traditional system of space and technology sharing, protected areas) and we try to simulate the consequences of various management tools.



## Ecosystems, Biodiversity & Development

Maintaining biological diversity and ecosystem integrity while human development proceeds presents a major challenge for ecological economists. This theme will highlight projects and methodologies that attempt to reconcile a healthy life-support system with a human cultural development at a variety of scales.

### Panelists

1. Rodrigo Gámez, *Instituto Nacional de Biodiversidad, Costa Rica*
2. Sixto Roxas, *Foundation for Community Organization & Management Technology, Philippines*

**Chair:** Marilia Pastuk, *Federal Rural University of Rio de Janeiro, Brazil*

### Creating the institutional setting for sustainability: a community management and accounting protocol

Sixto K. Roxas  
*Foundation for Community Organization & Management Technology*  
The Philippines

The paper poses the possibility of the community as the paramount unit of organization in the economy and its net income and net worth the overarching measurements of economic performance. This does not eliminate enterprise. It merely makes enterprise accounts subsidiary to community accounts, instead of, community accounts being subsidiary to enterprise, as in company towns.

This makes the economy a community rather than an enterprise system and would view national incomes as consolidation of community rather than enterprise incomes.

But can such a system be made "operational"? Let us first understand precisely what "operational" means. The best way is to see in what ways the enterprise system has been operational for these several centuries. The operability criterion requires that it be made up of constituent units, each with the following properties:

- The unit must be an organization with a system of authorities and mechanisms for control.
- It must have an operating technology that relates the control levers to the operating variables with predictable parameters, i.e. it must lend itself to rational management.
- It must have a defined set of stake-holders and beneficiaries and a system of governance that gives the stakeholders a say in the primary and secondary goals that the unit must seek to accomplish and the tolerable costs and trade-offs and order of priorities that shall govern its choices.
- It must have a suitable accounting system to monitor its performance, track its course and articulate for the information of its stakeholders how it is achieving or failing to achieve its short - and long-term objectives.

- It must have a set of professional managers trained in the technology of running the unit's operating system.
- It must be linked to other units in successively larger belongs.

The paper seeks to flesh-out an operational model of a community. Enterprise management has develop into a hard-nosed science and art because the concept of enterprise has had the benefit of translation into a clear, unambiguous operating model, with performance standards measured through an elaborate accounting system, and operating protocols embodied in textbooks with principles and cases. The questions: can the concept of a community be similarly fleshed-out?

Two reasons dictate that it should be:

- Enterprise management excludes responsibility for the ecology. This is the reason economists agonize over the problems of "externalities" -- precisely because the whole of the environmental consequences of business operations are external to the enterprise and must be tortured back into consideration to accommodate environmental costs.
- An authentic sustainable development program must be designed as a consolidation of sustainable development programs at the level of sustainable developing communities, meaningful only because the responsibility for carrying them out are clearly defined at each of these levels, the managers are trained to implement those programs, and the accounting systems monitor the performance of the managers.

This implies that there needs to be exercised in the community, in some mode and through some formality, the role of *manager*. What are the

implications of that role? It assumes the community to be an "organization" of particular characteristics, and the managers are practitioners of a defined science and art.

The discussion will proceed as follows. In the selection of the appropriate unit of organization, analysis, management and accounting, we shall attempt to integrate the ecological considerations so that they become part of the mainstream decision process.

"Community" has a very precise meaning in ecology as a group of "populations" coexisting in a contiguous territory. Within that territory (landscape) each population thrives in a particular place which is its "habitat" and "ecological niche" is the term applied to the ecological role of the species in its community.

The paper attempts systemically to integrate ecological elements into organizational structure and behavior. "Community" encompasses populations of other living species as well as their habitats. Thus defined, community economics goes beyond merely

We describe the structure and operations of this community as an organization. We define the accounting system that would track the performance of the community as an organization - its balance sheet showing its stock of resources as of a point in time and its liabilities and consolidated net worth, and then its periodic income flows, the gross income and the net after considering current and capital costs including the cost of maintaining natural resources to their state at the beginning of the accounting period, and then the allocation of net income between consumption and capital formation.

We discuss, how to manage the community in accordance with the logic of these accounts and then look at the problems of operationalization and filling the conceptual boxes with real numbers.

## Social & Ethical Dimensions of Ecological Economics

The day's second theme concentrates on the social and ethical dimensions, drawing attention to projects and methods that exemplify the importance of satisfying the biophysical criteria for sustainability at the same time that chronic social problems are substantively addressed.

### Panelists

1. Susan Hanna, *Oregon State University*, United States
2. Máximo Kalaw, *Green Forum Philippines*, The Philippines
3. Anil Gupta, *Indian Institute of Management*, India

Chair: Marília Pastuk, *Federal Rural University of Rio de Janeiro*, Brazil

### The ecology of property and natural resources

Susan Hanna  
*Oregon State University*  
United States

Degradation of ecosystems and increases in rates of species extinction have directed new attention to the ways humans own and use natural resources. Property rights systems are a coordinating mechanism between humans and their natural environment; they are institutions that define privileges and duties in the use of natural resources. Property rights systems embody economic incentives, social norms, and ethical standards, all of which affect the natural environment. The interaction between property rights systems and natural resources defines their ecology, and determines whether the resulting patterns of resource use sustain ecosystems or lead to ecosystem

degradation.

The emerging field of property rights studies is yielding new insights into the ecology of property and natural resources. This paper presents an overview of the development of knowledge in this field in the context of four questions: What does it mean to own natural resources? What do we require of natural resource property systems? What are the characteristics of enduring property systems that sustain resources? How do we build property rights systems that reflect the ecological, economic and ethical context?

## The social and ethical dimensions of ecological economics

Maximo Kalaw, Jr.  
*Green Forum Philippines*  
The Philippines

Current economic paradigms and practices have become fundamental causes of social disintegration and destruction of ecosystems. The globalization of capital and technology has concentrated these resources in a few large corporations and marginalized communities and the poor who can not be effective market players in global markets.

Ecological economics beyond environmental economist's stretching of neo-classical tools promises a fundamental shift in paradigms by providing the social and ethical considerations and values to address our crisis.

Consideration of scale specially when accessed on community level consultations become operational terms for carrying capacities and the ethical practice of compassion. It provides multi-level relations between people and natural systems that translate to community bonding and caring for others and future generations.

The distributive focus is a fundamental imperative for addressing the poverty gap and manifesting ecological and social justice. With the failure of the ideological response of Communism and Socialism to these problems it becomes more important that their legitimate goals of social justice

be addressed in a fundamental shift in economic management. Community based resource management, community accounting systems, cooperatives and ecological consumers unions are among promising mechanisms.

Focus on new units of management and organization such as ecosystem, culture, and ethnicity and "public management" provide the impetus for the search and creation of new tools and technologies that consider processes closer to the realities of the life flow in communities and societies. It provides trans-disciplinary considerations that calls for articulation of systems values and ethics. On a personal level it looks at the management of consumption, waste and lifestyles which is the bottom line necessary for sustainable development.

The above premises enhance the allocative efficiency of markets by bringing into the "market" different of values and empowering new actors to be equal market players.

Ecological economics can be a generative process that bring in untapped sources of creative energy such as our Nature traditions and great Spiritual practices in a co-evolutionary praxis of sustainable development.

## Social and ethical dimensions of ecological economics

Anil K. Gupta  
*Indian Institute of Management*  
India

Ecological Economics makes nature as a fulcrum of discourse on development. It is obvious therefore that the perception of scarcity of a resource and its consequent price would imply making value judgements about our own preferences. These

judgements are inevitable in any economic appraisal of human choice. In conventional economics, the preferences revealed in the market place were expected to manifest relative judgements that different subsets of society made about a given

resource. The anthropocentric view obscured the rights of perfect strangers i.e. the unborn and the other non-human sentient beings.

I submit that the perception of nature outside is linked crucially with our own nature within. It is this nature of ourselves which shapes our values and norms regarding our needs, demands, duties and responsibilities.

The disadvantaged households in high risk environments have conserved biodiversity even by remaining poor themselves. Their ethics prevents them from shortening their time frame and increasing their discount rate. Both these conditions explain much of the accumulation of wealth at the cost of sustainable resource \_\_\_\_.

I draw upon the folkloric tradition of knowledge as well as the insights from the grassroots innovators. The range of ethical values that govern the behaviour of communities will be presented to draw lessons for analysing economic choices. Since

choice of technologies for resource use are often made in an institutional context, I will describe the norms and values created by different formal and informal institutions.

Finally, I argue that social and ethical aspects of ecological economics influence the assumptions made in any casual model about the realm of responsibility of human actors. The ecological economics as a discipline would grow if these judgements are made explicit. In a way, the ethical dilemma and value conflicts have often been analyzed when things have gone wrong. By putting these values in the centre of discourse, we can avoid having to celebrate a situation where an operation is successful eventhough the patient \_\_\_\_.

The social construction of meanings about ecological and economic choices should not be like a rear view mirror which tells us accurately about the path we have travelled without giving any clue about where to go.

## **Social and Ethical Dimensions of Ecological Economics**

### **Reconceptualizing Development in the Context of Sustainability**

#### **Panelists**

1. F. Qu, A. Kuyvenhoven, N. Heering and T. Rheenen: *Sustainable development in China's agriculture: past experiences and future potential*
2. Jiahua Pan: *Ecological economics of large investment projects in developing countries: the case of China's Three Gorges Dam project*
3. Jonathan Harris: *World agriculture: regional sustainability and ecological limits*
4. William Moomaw and Mark Tullis: *Charting development paths: a multicountry comparison of CO2 emissions*

**Chair:** Neva Goodwin, *Tufts University, United States*

#### **Sustainable development in China's agriculture: past experiences and future potential**

F. Qu, A. Luyvenhoven, N. Heering and T. Rheenen  
*Wageningen Agricultural University*  
The Netherlands

Sustainable development has recently been included in the agricultural policy framework in many countries at the national level. Significant differences of basic situations such as the ratio of population to land, the types of environmental problems and the economic level between developed countries and developing countries, however, require different ways to achieve and determine sustainable development in agriculture. Especially for developing countries, it is very important to search for a path of sustainable agriculture that can effectively deal with specific issues such as food shortage, rural poverty, and environmental degradation with increasing population.

Because of destructive impacts on the environment, which resulted from the efforts to increase grain output and to meet other economic objectives, China has increasingly paid attention to the practices of sustainable agriculture which better suits its own national conditions since the beginning

of 1980s. This paper is to evaluate the characteristics and effects of sustainable agriculture in China in order to draw some useful conclusions for further development of the SARD in China and other LDCs as well. First of all, the development process of sustainable agriculture in China is analyzed and its characteristics are distinguished from those in developed countries. Although it is a gradual process in research activity and policy practice, the development of sustainable agriculture in China was originally directed by eco-economic principles and thus has significant characteristics. They are (1) the emphasis on the integration of food security, income generation, and ecological and social impact improvement in goal choice; (2) the application of full or multi-layer use of resources and diversified structure of agroecosystem in strategic measures; (3) wider scope including cropping, forestry, animal husbandry, fishery, processing and environmental engineering industry in industrial organization; (4) high input system of techniques and labors, and less

emphasis on reduced chemical uses; and (5) active initialization and effective intervention of government. Then the evaluation of sustainable agriculture practices in China is presented through macro analysis and specific case studies by the means of the indicators and method of multi-criteria evaluation. From macro point of view, sustainable development has been becoming main strategy of agricultural and rural transformation and eco-economic structure of agricultural production has been transformed expectedly, which leads to primary improvement of ecological stability, Integrated system of techniques is resulting in more innovation and application of new techniques, and will lead to further reform of agricultural and biological technology. Ecological product market such as "green food" label primarily arising from sustainable agriculture implies the emergence of efficiently functioning markets in natural resource and environmental services. Intensive input of labors in sustainable agriculture to some extent is alleviating the pressure of increasing population on sufficient employment. From micro point of view, the structure of agroecosystem in pilot areas is optimized according to eco-economic principles and local

conditions. In most programmes of sustainable agriculture at different levels, ecological goal and socio-economic goals have been integrated successfully and ecological, economic and social benefits have improved simultaneously. In some cases, although the short-term economic benefits are not significant, after the improvement of ecological base the long-term benefits will be ecological, economic as well as social. Aiming at dealing with remaining problems, some strategic suggestions also are discussed in the last part of the paper. A special emphasis of the paper has been given to exploring the contribution of sustainable agriculture in China to the goal of the SARD and to drawing some useful conclusions for other LDCs. Primary conclusions include (1) the determination of effective goal system of sustainable agriculture depends on the correct understanding of nationally physical and socio-economic conditions; (2) sustainable development should coincide rural transformation especially traditional agriculture reform; and (3) active initialization and effective intervention of government are necessary for successful development of sustainable agriculture.

### **Ecological economics of large investment projects in developing countries: the case of China's Three Gorges Dam project**

Jiahua Pan

*Institute of World Economics and Politics, Chinese Academy of Social Sciences  
Republic of China*

After decades' debate, China's Three Gorges Dam Project was officially approved in April 1992 and is now under construction. total investment is estimated to be over 100 billion Renming be yuan (RMB Y. 5.7 RMB Y = 1 US dollar). The largest ever in China's economic history. Its hydropower generating capacity totals 18.2 million KW. the largest of its kind in the world. About 1.2 million people are to be removed from the affected area and resettled elsewhere. The most difficult and expensive that has ever been involved in a single development project. Existing official economic and ecological appraisals claim that this investment

project is economically feasible and environmental sound.

Hydropower, improved navigation, irrigation potential and flood control capacity can be considered human-made natural assets since they are able to substitute natural resources. At the same time, this huge investment project will bring about changes of landscape, local ecosystems, hydrogeological features and biodiversity, some of which are believed irreversible with uncertain outcomes. In other words, it both enhances economic and ecological capacities in the region and

generates adverse impact on the ecosystem and the environment.

With specific reference to the Three gorges Dam Project as outlined above, this analysis goes a step further to investigate the ecological economics of large investment project in a developing country like China. More specifically, this study concentrates on examining the following aspects of capital investment: substitution between human-made capital and natural assets, shadow projects for ecological rehabilitation, local and regional ecological system balances and environmental resource accounting.

Cost-benefit analysis and game theory are employed in the study to compare the gains and the

social and ecological costs from the project and suggest practical approaches to its management. The results show that, if the capital gains are reinvested in ecological rehabilitation, it is likely that the project will enhance the overall ecological-economic system. Nevertheless, this observation is complicated by irreversibility and uncertainty. If net gains from human-made natural assets are transferred to other systems, local system degradation may occur and cause possible ecological catastrophes, which in turn may result in considerable social costs in the economy. A general project requires ecologically sound management so as to achieve enlargement of ecological and economic capacity through capital investment in capacity building.

## World agriculture: regional sustainability and ecological limits

Jonathan M. Harris  
Tufts University, Medford  
United States

The literature on global agricultural production is characterized by dramatic differences in evaluation of possible future growth paths. There is no question that world agricultural output must grow at least sufficiently to accommodate expanding population, but there are wide differences in estimation of the potential and of the sustainability of the future world agricultural system. At one end of the spectrum, authors such as Lester Brown of Worldwatch Institute argue that ecological limits in agriculture have already been reached and exceeded. At the other, studies such as those by Paul Waggoner and David Seckler project a global food demand for the twenty first century well within the capacity of agro-ecosystems to supply, taking into account both declining population growth and increasing crop yields. This paper offers an approach to the evaluation of this latest manifestation of the Malthusian debate.

Standard economic analysis offers essentially no theoretical limits to growth in agricultural output. Ecologically-based analyses can establish limits to

carrying capacity based physical production potential. These formally calculated limits, however, generally exceed probable global demand and so do not provide *a priori* support for a Malthusian hypothesis. However, a different story emerges from an analysis of regional sustainability and actual environmental impacts of present agricultural practices. In specific regions, different problems such as fertilizer runoff, soil erosion and degradation, pressure on marginal lands, water supply limits, degradation of irrigated lands and depletion of aquifers bulk large. These ecological problems tend to be masked by global figures on yield and output, possibly leading to excessively optimistic conclusions.

The essential requirement for long-term sustainability is "decoupling" agricultural yield increases from increasing inputs of evidence that this can be accomplished, and it is this trend rather than technological optimism based on the perceived success of high-input agriculture which may lead to regional, and therefore global, sustainability. Nonetheless, the existing and predictable problems



based on credible population and demand projections are immense. This paper suggest a regional approach to issues of agricultural sustainability, and identifies

some major difficulties in the transition to sustainability for key regions.

## Charting development paths: a multicountry comparison of carbon dioxide emissions

William R. Moomaw and D. Mark Tullis

*The Fletcher School of Law and Diplomacy, Tufts University  
United States*

Research over the past 20 years has shown that the relationship between energy use and economic growth is not linear, as previously thought. This assessment is extended by analyzing empirically the historical relationship between economic output, in this case, measured in GDP per capita, and per capita emissions of carbon dioxide for different groups of countries. By utilizing a two-dimensional resource-wealth correlation diagram, which we call "the development plane", it is possible to view the historical relationship between economic output and carbon emissions and chart the relative positions a number of countries selected from different nation groups, e.g. OECD countries, Planned economies,

industrializing countries, and low-middle income oil producing countries.

Country analyses show that carbon intensity differs widely, even among countries with similar levels of industrial activity. In advanced industrialized economies carbon intensities have, in general, continued to fall, whereas trends in the less stable authors conclude that of the many different development paths, some are capable of producing rapid economic growth with relatively low carbon emissions. Importantly, the data show that market economies can grow even while curtailing their carbon emissions.

## Social and Ethical Dimensions of Ecological Economics

### Sustainability and Employment

#### Panelists

1. Carlos E. Frickman Young: *Natural resources, investment and employment: a macroeconomic model*
2. Carlos Roversi:

Chair: Arlette Pichardo, *Universidad Nacional, Costa Rica*

#### Natural resources, investment and employment: a macroeconomic model

Carlos E. Frickman Young  
*University College London*  
England

Environmental economics models focus on long term problems, such as sustainability and growth constraints. However, only a few models provide a linkage between long term problems and short term macroeconomic problems. Since most of the models assume full employment of capital and labor in the short term, consideration of unemployment is often omitted, despite the growing concern about this issue both in developing and developed countries.

In order to stimulate the discussion about the potential links between these sets of short term and long term goals, the paper presents a macroeconomic model which relates the determination of income in the present with the capacity of the economy to generate income in the future. The model is based in a modified Harrod-Domar-Kalecki equation to determine the investment and natural resource depletion levels necessary to reach full employment (the short term objective), combined with a long term objective of non-decreasing total capital stock (the "weak" sustainability restriction). The total capital stock is determined by the sum of the monetary values of both produced ("man-made") and non-produced ("natural") assets.

The model highlights the dual macroeconomic effect of natural resource depletion. On the one hand, depletion contributes to increases in the current level of activity. On the other hand, it implies a smaller availability of economic assets in the future. Decreasing the depletion rate can help the long term objectives, but it can lead to unemployment levels which developing countries can not afford in the present. The combination of rising investment in produced assets and smaller rates of depletion appears to be the best solution in such cases; however, this combination rarely appears in developing countries.

The paper concludes with an application of the model to the debate about the natural resource consequences of adjustment programs. An illustration is provided using secondary data for Indonesia and the Philippines. Finally, potential improvements of the model, such as an extension to pollution problem, are discussed.

## Social and Ethical Dimensions of Ecological Economics

### Institutional Transformation

#### Panelists

1. Katherine and John Peet: *Global learning for sustainability: with people's wisdom*
2. Peter Neame and Rusdian Lubis: *Policies and institutional structures for the promotion of sustainable development in Indonesia*
3. Liza Fendt: *Ecology and economy: a universal background*
4. David Kaimowitz: *Two political economy of environment management -Latin America case-*
5. Clyde Kiker: *A procedure for ecological economic analysis and planning under imprecision*
6. Juan Camilo Cárdenas: *Empirical evidence of ecological and economic factors influencing the environmental degradation: the case of the tropical and andean regions*
7. Peter G. Brown: *Restoring the public trust*
8. John Erskine: *Institutional restructuring for sustainable development in South Africa's less developed rural areas*

**Chair:** Lizardo de las Casas, *Inter-American Institute for Cooperation on Agriculture,*  
Perú

#### Global learning for sustainability: with people's wisdom

Katherine and John Peet  
*University of Canterbury*  
New Zealand

In the paper we consider some strategies for education about sustainability. Our interest is in adult education, however, not the education of young people. The main reason is that, if we wish to change the direction in which society is going we need to start with the principal decision-makers - adults - in the expectation that schools will then be able to respond.

Even with this reduction in scope, it is still a large issue. For example, who are we trying to "educate" about sustainability? Is it the masses in the industrialized north, who consume a disproportionately large quantity of the world's resources, or those of the south, where rainforests are

being cut and deserts created? Is it the elite of both, or the masses over whom the elite hold financial, political or military power? Is it all of these?

Whatever the answer to our questions, different approaches must be used for different groups. There is a context for each, to which the adult education strategy must respond.

Here we take a somewhat simplified approach, in that we describe the topic in terms of two adult education models, the "consensus" and "conflict" paradigms. They differ fundamentally in their views of the structure of society, and in their notions of inequality. While it is tempting to do so, we do not

suggest that they simply reflect north and south, right or left. As a generalisation, however, we believe that there is evidence that the poor and vulnerable are already living more sustainable lifestyles than the rich and powerful. Given the

opportunity to do so they would live even more sustainably. The opportunity to do so is closely involved with the need to give them the confidence to see themselves as in fact the leaders, as we move towards the 21st century.

## **Policies and institutional structures for the promotion of sustainable development in Indonesia**

**Peter Neame and Rusdian Lubis**

*Indonesian Environmental Impact Management Agency  
Indonesia*

Indonesia is responding to the needs to ensure sustainability of its natural resources, ecosystems structure and function and human resources through a multi-pronged strategy of development of policies, procedures and institutions. This paper reviews Indonesia's approach, focusing on the policies and structures that are in place as well as those that are in planning or still needed, and indicates the lessons that can be learned from this experience.

Indonesia's comprehensive environmental impact assessment procedures have been in place since 1986 and have been the first and the main tool for attempting to ensure that the broad range of environmental concerns (physical, socio-cultural and economic) are incorporated into development planning. These EIA procedures are now recognized and well established, but have experienced various problems in implementation. They have recently been updated and are now expected to provide the legal and administrative basis for regional impact studies. Such a regional approach to impact assessment will be closely linked to other recent legislation establishing a spatial planning process. Other supporting actions to: a) establish ambient environmental and effluent quality standards,

b) develop an environmental information system, and c) implement clean technology and other economic incentive systems are underway and are also expected to contribute to creating a comprehensive framework for environmental management which will meet the national goals for sustainable development.

Indonesia's experience to date in development of policies, procedures and institutions indicates the major importance of attention to human resource development, as well as the need for application of a diverse array of mutually-supporting instruments and structures for ensuring sustainable development and appropriate environmental management.

Prominent realms for manipulating these incentives are resources access, market demand, collection costs, and conservation benefits (including who benefits and who pays). The strategies exhibiting the highest degree of transferability include strategies which aim to raise the cost of egg collection by increasing collectors' opportunity costs and those which enlist the beneficiaries of non-consumptive use values, existence values and option values of sea turtles to help cover the costs of conservation efforts.

## **The political economy of environmental management Latin America case**

**David Kaimowitz**

*Inter-American Institute for Cooperation on Agriculture  
Costa Rica*

The main concern of the paper is to understand the logic of decision making concerning environmental policy and Latin America and explain under what conditions decision makers may be willing and able to promote a more rational use of natural resources and the environment. The paper is organized around three basic hypotheses.

The paper's first working hypothesis is that government leaders will not take serious measures to reduce natural resource deterioration unless they are pressured to do so.

Based on that hypothesis the paper examines both the potential and limitations of seven social forces that might exercise pressure to bring about a more rational management of natural resources: i) extra/regional forces such as governments and NGO's from the developed countries, multilateral banks and international organizations, ii) the urban middle class, iii) businesses that see the environment as an opportunity to make money, iv) farmers and

communities affected by pollution, v) indigenous movements, vi) professional environmentalists, and vii) political parties and social movements concerned with social justice.

The paper's second working hypothesis is that of the greatest obstacles preventing the Latin American state from taking action to promote rational natural resource management are a) the dependence of the current model of capital accumulation on the over-exploitation of human and natural resources in order to compete on the world market, and b) the power of international lending institutions.

The third hypothesis is that, for the state to be able to intervene to ensure more rational natural resource management, it must have a well developed bureaucratic apparatus somewhat autonomous of the ruling classes and the design of that apparatus would have to reflect the specific requirements of environmental management.

### **A procedure for ecological economic analysis and planning under imprecision**

**Clyde Kiker**

*University of Florida  
United States*

Knowledge about relationships between human activities and ecological processes is most often vague and ambiguous, at best it is fragmentary. In an analysis and planning effort, each participant brings a different view, and each of these views have a substantial degree of uncertainty: uncertainty in the understanding of the functioning of an "ecosystem", uncertainty in how the possible actions might affect the ecosystem, and uncertainty in what

the term "sustainability" means relative to the actions and the ecosystem. A reasonable goal for the analysis and planning process is to narrow the range of uncertainty associated with the possible actions put forward to those delegated decision making power.

The approach used here is based on Zadeh's fuzzy logic and approximate reasoning and Kosko's

fuzzy systems. In these works and others, uncertainty is recognized as being due to a system's complexity, incomplete information and imprecise human perception, thought and language. Each participant brings knowledge and perception of natural phenomena and possible actions to the exercise. Each participant is viewed as an "integrator" of "fuzzy knowledge". They operate as "adaptive associated memories" that associate fuzzy outputs (consequences) with fuzzy inputs (actions), and the group as a whole are viewed as a system of parallel processors. Exercises and software are used to establish fuzzy expression of

input information, possible actions and the degree to which the possible actions are supported.

It is recognized that arguments and criticism arising out of vagueness and ambiguity can be frustrating, destructive and counter productive. The procedure is offered as a means to reduce this possibility. And in that spirit, participation is not limited to only scientist, experts and policy makers, but also includes representatives of communities. The overall goal is not to come up with the "optimal" action, or even one that everyone agrees upon, but instead, it is to arrive at sets of actions that can be put forward with acceptable degrees of support.

### **Empirical evidence of ecological and economic factors influencing the environmental degradation: the case of the tropical andean regions**

Juan Camilo Cárdenas  
*Universidad Javeriana*  
Colombia

Based on the Boyacá region of Colombia, a model and database were developed to integrate economic concepts such as natural capital, externalities and agrarian institutions with the systemic views of (agro)ecosystems, through a spatial model using Geographic Information Systems.

Using the database the model integrates ecological, technological and institutional factors affecting the environmental externalities which ultimately influence the agroecosystem health, understood as the product of vigor, organization and resilience (Costanza, et. al.eds, 1992).

The ecological and economic particularities of these campesino regions impose several restrictions to conventional economic approaches. Through the concept of ecological verticality in the Andes, the interdependence of soils, vegetation and water, and the problem of downstream externalities are addressed.

Using the model, the level of environmental degradation or conservation was explained by the available natural capital, the agricultural practices and

land uses. The positive correlation between externalities and natural capital supports the idea of the economic benefits from the ecosystems. Likewise, the variables describing the technological practices in the agroecosystems were explained through the institutional factors, such as land tenure and population density.

The results found reject the literature blaming the degradation directly on increasing rural population by showing that its estimated marginal effect is a combined result where population increases the likelihood to engage in sustainable agriculture practices as well as the bias towards crop production.

Land inequality decreased the likelihood to engage in sustainable agriculture practices, and at the same time induced a bias towards livestock land uses.

Given the importance of population and land inequality in developing agrarian economies a further model was formulated where cross-effects from population and inequality are considered. using the

same data set, the new model and results improved the efficiency of estimation and confirmed

the hypotheses that such cross-effects do matter.

### **Restoring the public trust**

**Peter G. Brown**  
*University of Maryland*  
United States

Restoring the public trust supplies a theory of governmental legitimacy that undergirds the development of a sustainable society. It argues that both the right and centrist versions of state legitimacy based on the ideas of market failures fail. Key terms like "externalities" and "public goods" fail to supply and adequate foundation for public policy.

In contrast, the idea of the public trust as set out in John Locke's *Second Treatise*, grounds an agenda for protecting the vulnerable, securing the integrity of public office, and protecting/restoring the environment as part of an integrated theory, of the duties of government to this and future generations.

### **Institutional restructuring for sustainable development in South Africa's less developed rural areas**

**John M. Erskine**  
*University of Natal*  
South Africa

Where there is too much uncertainty about the costs and benefits of sustainability, or too much disagreement about values, equity, or balance, decision-making about the use of natural resources becomes very difficult. This is in fact the situation that obtains at present in respect of South Africa's less developed rural areas. In such a situation, there is a need for the development of an institutional framework, at national, regional and local levels, to examine, evaluate, decide on, and regulate the degree of individual and collective responsibility for protecting various types of natural resources without denying people the opportunity to use these resources for wealth creation.

In the paper, attention is given to the likely ecological economic linkages associated with political restructuring in a changing South Africa. The potential environmental impacts of land redistribution

are examined with particular reference to market-based and non-market estimates of the costs and benefits associated with the redistribution process.

Poverty can only be overcome through wealth creation but there is a need to ensure that sustainability is built into employment creation programmes. A framework is developed for institutional restructuring that is designed to ensure sustainable development; this includes making provision for (a) the proper planning of sustainable development, (b) resource accounting, (c) the application of ecological economics at community level (justifying sustainability, information distribution, overcoming the "tragedy of the commons"), (d) the use of incentives and disincentives to promote sustainable use of natural resources, and (e) ecosystem restoration and conservation.

Racial, gender and ethnic equity in the distribution of natural resources are recognized as vital components of sustainable development. The importance of these considerations is highlighted in

a description of some examples of practical ("down to earth") applications of ecological economics to achieve sustainable development in South Africa's less developed rural areas.



## Social and Ethical Dimensions of Ecological Economics

### Ecoturism and National Parks

#### Panelists

1. Carlos Manuel Morera and Sinaf Badilla: *Tourism in Costa Rica: initial modifications of land tenure in the marine terrestrial zone*
2. Alan T. White and David Mc Cauly : *Coastal environment and tourism: can Hikkaduwa, Sri Lanka, afford to clean-up?*
3. R. Kerry Turner, Katrina Brown, Hala Hamewed, Ion Bateman: *Ecoturism in environmentally fragile areas: case studies from the Maldives and Nepal*
4. Sally Driml and Michael Common: *Towards sustainable turismo: the great barrier reef and wet tropics world heritage areas*
5. Carmen María Rojas: *Monteverde Cloud Forest Preserve: links between the forest preserve, the local community, and tourism*
6. Eric D. Mungatana and Stale Navrud: *Environmental valuation in developing countries; the recreational value of wildlife viewing*

**Chair:** **Alfio Piva, Instituto Nacional de Biodiversidad, Costa Rica**  
**Juan Humberto Cevo, Universidad Latina de Ciencia y Tecnología, Costa Rica**

#### Tourism in Costa Rica: initial modifications of land tenure in the marine terrestrial zone

Carlos Manuel Morera y Sinaf Bonilla  
Costa Rica

An ecotourism boom affects the local economy in four ways: by generating employment other than agricultural employment; by increasing the inflation in land prices; by creating changes in soil use; and by creating incentives for local producers under the so-called diversification and expansion of production themes (O'Ferral, 1991). Costa Rica's ecotourism boom, which began at the end of the 1980's, has turned tourism into the highest earner of foreign currency in this country.

The lack of planning and coherence by the Costa Rican State - which wasn't ready for the new direction that the economy has taken - is reflected in a series of tourism vs. environment conflicts, in cases like Tambor, Gandoca-Manzanillo, and Papagayo.

The daily number of visitors to several national parks has exceeded their carrying capacities. As a result, travel operators are heading for new areas that are being opened for tourism. Until now, research which evaluates the effects of ecotourism on different activities in this country (environmental, social, cultural, and economic) has been scarce.

This study evaluates the present state of land tenure in the marine-terrestrial zone and provides possible explanations about its development. The land-titles in 40 counties in the marine-terrestrial zone are evaluated.

Nationally, Costa Ricans hold 90.6% of all the land-titles in the marine-terrestrial zone, compared to

4.1% in the hands of foreigners. However, foreigners own some key areas in the marine-terrestrial zone, particularly the areas which are close

to protected areas, or to areas that need to be protected, demonstrating a tendency for local people to lose control of the land.

### **Coastal environment and tourism: can Hikkaduwa, Sri Lanka, Afford to clean-up?**

**Alan T. White**  
*Coastal Resources, Management Project*  
Sri Lanka

Hikkaduwa is one of the most densely developed tourism sites in Sri Lanka. The attractions of the area are related to the coastal setting and directly dependent on the quality of the beaches, marine water, coral reefs in the marine sanctuary and the general physical and social environment of the town. Although these resources are the main tourist attractions, there has never been an analysis of the economic value of these resources or an economic justification made for their rehabilitation, management and protection.

This paper analyses the tourism generated economy of Hikkaduwa in relation to the dependence of the tourism industry on the coastal and environmental resources. It quantifies the tourism business sector in terms of employment, revenues, profits, formal and informal sector relationships and the environmentally related problems of Hikkaduwa visitors as perceived by the business community. It elaborates the nature of tourism habits and the

general perception of the foreign visitors, their expenditures and concerns on the environmental situation. An evaluation of the impact of tourism activities on the environmental resources is made. The relative direct and indirect costs and benefits of tourism in relation to the Hikkaduwa environment are compared with the investment required to improve the environmental situation of the area.

It is concluded that the relative lack of investment by the tourism industry and the government in the maintenance of the Hikkaduwa environment is contributing to its degradation and to a decline in the quality of tourists attracted to the area. Cost-benefit analysis supports a case for collecting a tourist tax which is reinvested in local coastal resources management. Foreign exchange earning levels justify national government investment in infrastructure essential for improving the physical environment of the town such as the road and traffic congestion and noise.

### **Ecotourism in environmentally fragile areas: case studies from The Maldives and Nepal**

**R. Kerry Turner, Katrina Brown, Hala Hamewed, Ion Bateman**  
*University of East Anglia, Norwich*  
United Kingdom

The paper develops a general model of ecotourism, based on concepts of open access and renewable resources. The experiences of two

economies highly dependent on tourism the Maldives and Nepal, are compared and contrasted. Although these countries offer very different attractions to

tourists; on the one hand, coral reefs, watersports and tropical beach recreation, and on the other mountaineering and trekking, the areas suffer similar problems in terms of adverse environmental impacts of tourism. The dominant impacts in both areas are those associated with solid waste disposal and water resources. These are compounded by the depletion of natural resources; by severe deforestation in Nepal, and in the form of damage to coral reefs in the Maldives.

Both countries are currently employing "dispersal" techniques to overcome the adverse impacts of tourism. In Nepal, this involves opening

up new areas, for example Mustang, and encouraging small-scale tourism development in rural areas, such as the Annapurna Conservation Area. In the Maldives new developments are being initiated on hitherto uninhabited atolls. Neither strategy is without serious environmental costs, nor do they address the fundamental problem of maintaining tourism revenues whilst minimizing environmental damage. We apply data from the Maldives and Nepal to a model of tourism demand and "tourist carrying capacity". The lessons learned from the experience of Nepal, which has encouraged high volume budget tourism to remote undeveloped regions, is utilized to develop a proposal for a sustainable tourism strategy for the Maldives.

## **Towards sustainable tourism: the great barrier reef and wet tropics world heritage areas**

Sally Driml and Mick Common

*Centre for Resources and Environmental Studies, Australian National University  
Australia*

North Queensland, Australia, has two World Heritage Areas located side by side. These are the Great Barrier Reef, the world's largest coral reef system, and the Wet Tropics World Heritage Area which preserves the majority of Australia's tropical rainforests.

Management Plans are in force for the GBR and are being developed for the Wet Tropics. Some uses have been banned, notably oil drilling and mining on the GBR and logging in the Wet Tropics. All other uses are being managed with the intention of allowing economic development consistent with the underlying conservation objectives for the areas. There has been a significant increase in tourism to these areas in the last decade. All tour operations require a permit and are subject to conditions particular to the area and type of operation.

These natural areas, along with warm weather,

are primary tourist attractions to North Queensland. Significant development of infrastructure outside the WHAs, particularly in the city of Cairns must in part be credited to the attractions of the WHAs. Tourism provides an important source of diversification of economic activity. Annual expenditure in the region associated with tourism to the WHAs has been estimated at over AU\$1 billion.

Tourism may enable the realization of the benefits of conservation in a tangible way. The potential costs associated with tourism development are environmental degradation in the WHAs and in the adjacent cities and towns. The main challenge to managers is having sufficient information on impacts to allow decisions to be made to keep the level of impacts low consistent with the objectives of management and gaining sufficient funding for appropriate management.

## **Monteverde Cloud Forest Preserve: links between forest preserve, the local community and tourism**

**Carmen María Rojas**  
Costa Rica

Tourism has been increasing in Costa Rica since 1986. Most tourists visit protected wild areas during their trip. This increasing number of nature-oriented and scientific tourists (researchers and students) can be attributed to: the peaceful nature of this country; the positive social situation (in comparison with other Latin American countries); the immense biological diversity, and finally; the protected areas system (State and private) that was initiated in 1913.

The Monteverde Cloud Forest Preserve is one of the most frequently visited protected areas in the country, generating 40,132 person-days in 1991. Tourists support approximately 70 different services in the area: lodging, restaurants, guides, slide shows, horse renting, art galleries, packed food, laundry, gas station, butterfly farm, private trails, and transportation. These services are owned by approximately 54 local families. There are approximately 250 employees working in these businesses, most of them from the local community. These businesses generate most of their income during the high tourist season (December-April), although

some of these services are used by local people throughout the year.

It has been said over and over that nature-oriented tourism is benefitting the tropical forest as well as the rural communities which are adjacent to them. However, there are few examples in the world where these benefits have been proven. (Especially the economic benefits for an importing country like Costa Rica.) How much of foreign currency generated by tourism "goes out" of the country again?

This paper examines the Monteverde case in order to explore the links between the Preserve, the local community, and tourism, and attempts to ascertain where the tourism money goes. Ideally, part of that money should directly benefit the resource that is being used to generate it, in this case, the protected forest at the Preserve. One would also hope that this money would improve the standard of living in the community beside the Preserve.

## **Environmental valuation in developing countries: the recreational value of wildlife viewing**

**Stale Navrud and Eric D. Mungatana**  
*Agricultural University of Norway*  
Norway

Few environmental valuation studies have been carried out in developing countries. This study shows that the Travel Cost (TC) and the Contingent Valuation (CV) methods can be successfully applied to estimate the value of natural resources also in developing countries. These two independent methods were used to estimate the recreational value of wildlife viewing, and, thus, the potential economic

benefits of this activity to the developing countries that provide this amenity. The recreational value of wildlife viewing in Lake Nakuru National Park in Kenya was found to be 8-15 million USD per year. The flamingos accounted for more than 1/3 of the value. Recognizing that this is only one of many parks in Kenya, and that wildlife viewing is becoming an important part of the global trend of increasing

ecotourism, this clearly shows that sustainable management of the wildlife resources could provide a very significant and much needed revenue source

for developing countries in the future. The recreational value of viewing wildlife also provides a valid, but very conservative estimate of the total economic value of the wildlife species in the park.

## **Social and Ethical Dimensions of Ecological Economics**

### **Power, Prices and Ecological Distribution**

#### **Panelists**

1. **Eliot Muir and Martin O'Connor: *Property, prices and ecological distribution***
2. **Jan van der Straaten: *Sustainable development and distributional effects: the case of acid rain in The Netherlands***
3. **Richard Howarth: *Notions of obligation and distribution of environmental risks***
4. **Andy Dragun: *Structures of governance and the political resolution of forest us rights***
5. **Inge Ropke: *Technology and institutions vectors of power***
6. **James Boyce: *International trade and the environment: a power-theoretic approach***

**Chair:** **Martin O'Connor, University of Auckland, New Zealand**  
**Joan Martínez-Alier, Universidad Autónoma de Barcelona, Spain**

### **Property, prices and ecological distribution**

**Eliot Muir and Martin O'Connor**  
**University of Auckland**  
**New Zealand**

The purpose of this theoretical paper is problematise the "valuation" of environmental goods and services, by looking at valuation logics explicitly in the context of institutional and power determinants of "entitlements". We do this through a critical usage of a) neoclassical general equilibrium models, and b) some innovative neo-Ricardian modelling of uneven accumulation and degradation of natural capital. Using our models as explicit paradigms/parables, we show that what passes commonly for "valorization" of the environment through various mechanisms of pricing -- quasi-

market valuation procedures, inventorying of natural capital stocks, patenting of genetic lines as assets, etc., -- tends to work as a mechanism for redistribution of access to benefits of the environment towards already privileged economic groups/classes. The models thus help to guide effective critical appraisal of the likely redistributive consequences of various stratagems and policies such as tradeable catch quota for commercial fishing; gene patenting; promotion of "environmentally friendly" goods: carbon taxes; land and water use policies for environmental sustainability; and so on.

## **Sustainable development and distributional effects: the case of acid rain in The Netherlands**

Jan van der Straaten  
*Tilburg University*  
The Netherlands

After the publication of the report *Our Common Future* (World Commission on Environment and Development, 1987) sustainable development became rapidly the new magic word which could help to solve all environmental problems. In 1989 the Dutch government accepted this concept as a guideline for all their policies. This is generally seen as an important step forward aiming to protect the environment. One should not overlook, however, that already in the beginning of the seventies the Dutch Minister of Environmental Affairs wrote an important memorandum in which it was said that production and consumption should be brought into line with the limiting possibilities of the ecosystem. This statement became from that moment on a starting point of all Dutch policies. Though the term sustainable development was not used in this memorandum, it is clear that the content of this starting point do not really deviate from the sustainability concept of the Brundtland report. From the beginning of the seventies until 1989 this concept has often been used in the Dutch memoranda.

When the Dutch Minister on Environmental Affairs argued in the Dutch National Environmental Policy Plan (1989) that sustainable development would be the guiding principle to all Dutch policies, he did not make clear why the Dutch government did not reach a state of sustainability as a result of the environmental policies in the last decades. Neither

he demonstrated why it was necessary to decrease all acidifying emissions by 80 till 90 per cent. Why did the sustainability concept not work for a period of 20 years?

In the paper it will be demonstrated that the Dutch policy regarding acid rain failed due to the lack of attention from the government to the distributional effects of the measures to be taken. The result was that economic sectors suffering from the implementation of severe norms, started to neutralize the aims of the abatement policy. It will be argued in the paper that vested interest in the field of motor cars, intensive cattle breeding and air traffic were rather successful in this respect. This is one of the most significant causes of the failure of environmental policies in the Netherlands for the last decades. Present development make clear that these groups are able to frustrate future policies again.

From this case study the conclusion can be drawn that the sustainable development concept is a good starting point for the implementation of environmental policies. However, authorities should pay special attention to the distributional effects of their policies. The Dutch government played down the distributional argument as they were afraid of a sharp confrontation with vested interests. However, by doing this they gave these vested interests a very strong position as the instruments of the government were not suitable to meet this strong resistance.

## **Notions of obligation and the distribution of environmental risks**

**Richard Howarth**  
*University of California*  
United States

An important aspect of distributional justice in the environmental domain is the distribution of the "burden of risks" -- that is, the question of how exposure to dangers of serious industrial accidents (including new sources of risk such as genetic engineering experiments) and to endemic health hazards such as toxic wastes disposed of within the biosphere, is differentially distributed within

communities and nations, between countries (especially North and South), and between generations. This paper will use models of inter-temporal general equilibrium incorporating a variety of explicit rules about "just" or "reasonable" distribution of environmental risks, as a framework for exploring ethical and economic dimensions of this problem.

## **Structure of governance and the political resolution of forest use rights**

**Andy Dragun**  
*La Trobe University*  
Australia

The paper presents a critical appraisal of ongoing contest over access to a large stand of regenerating forest in the State of Victoria. At present, a variety of interests including logging industry groups, nature conservation interests, bodies responsible for provision of water supply to the Melbourne population, and various recreational groups, have staked their claims to future access to and use of forest resources. A number of cost-benefit studies have been undertaken to furnish estimates of aggregate costs and benefits of alternative uses. These valuation studies, while

being themselves open to criticism on a range of methodological and empirical grounds, nonetheless frame plainly the underlying distributional conflicts at the heart of the debate. It is shown how the likely resolution of these distributional conflicts is highly sensitive to the particular legal and institutional arrangements governing the forest. Lessons are drawn from this case study, for the importance of governance structures in any progress towards some sort of "sustainable" management of forest or similar complex natural resources.

## **Technology and institutional vectors of power**

**Inge Ropke**  
*Technical University of Denmark*  
Denmark

The paper analyses critically the interrelations between technology, environment, and distribution of wealth/income as joint determinants of change

patterns in industrial societies. Considered in historical terms, income distribution, technologies, and preferences/attitudes are endogenous within an



economic system. Technological choices are strongly weighted in favor of the economic and political objectives of wealthy sectors of industrial societies, and these choices contribute to the reinforcement of distributional inequalities (for example mechanization, telecommunications, unemployment). Similarly, the choices of technologies in industrial processes and transport, for example, mediate the shifting of social and environmental costs by powerful producers and consumer sectors onto less fortunate segments of society (or onto future generations). So technology

is an important connection between institutions and power on the one hand, and ecological distribution (along with income distribution) on the other. Environmental politics and popular pressure is pushing technological change in "environmentally friendly" directions, but there are strong vested interests working against this shift. These questions will be explored in conceptual terms, with detailed analyses of some trends in technological change in West European economies over recent years.

### **International trade and the environment: a power-theoretic approach**

James K. Boyce  
*University of Massachusetts*  
United States

This paper analyzes the environmental impacts of international trade in a power-theoretic framework, in which the extent of environmental degrading economic activities and the distribution of the associated benefits and costs depends on the balance of power between winners and losers. When power asymmetries exist among trading partners - as in the case of much North-South trade - the power theoretic framework predicts that the gains from environmentally degrading trade activities will tend to flow to the relatively powerful (Northern) partner, while the losses are borne by the relatively powerless

(Southern) partner. This prediction stands in marked contrast to the conventional view, exemplified in the recent NAFTA debate, which assumes that the main environmental threat in North-South trade is that environmentally responsible production in the North will be undercut by competition from environmentally irresponsible production in the South. Two cases are discussed to illustrate the explanatory power of the power-theoretic approach: the competition between jute and synthetic fibers, and the competition between Mexican and U.A. maize.

## Social and Ethical Dimensions of Ecological Economics

### Valuation Conflicts and Ecological Economics

#### Panelists

1. S. Kask, et. al.: *Valuing ecosystems: theory and measurements*
2. Héctor Segenovich:
3. Mauricio Cervantes: *Economic valuation of the "Estero del Soldado" mangrove: a case study of tourism's development in the San Carlos Zone, Nuevo Guaymas, Sonora*
4. José Lamartine Tavora Junior: *An attempt of incorporation externals variables to the economical financial analysis with locational intents*
5. Russell K. Blamey: *Citizens, consumers and contingent valuation*
6. Guiseppe Munda: *Multicriteria evaluation in the framework of ecological economics: some epistemological considerations*

Chair: **Edgar Fürst, Universidad Nacional, Costa Rica**

#### Economic valuation of the "Estero del Soldado" mangrove: a case study of tourism's development in the San Carlos Zone, Nuevo Guaymas, Sonora

Mauricio Cervantes Abrego  
*Coordinación para la Gestión de los Humedales de México*  
México

At the present time, there are no better transaction languages between two different regions in the world than market prices and market values. An economic appraisal analysis of environmental processes, and their components, will allow us to recognize their value and, furthermore, to compare them with other systems that are not necessarily natural, thus allowing us to set priorities. Developing countries, like Mexico, have adopted First World practices. These models have not always been successful.

This paper outlines a method for assigning economic value to mangroves and ecological processes. This study examines a recent tourist development called "Soldado de Cortés", which is located beside the "Estero del Soldado" estuary, and

attempts to establish cost/benefit approaches which could help future decision-making.

The "Estero del Soldado", in its northern latitude, is the last representation of a healthy red mangrove community (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*). There are about 160 invertebrate species, more than 100 fish species, of which 20 are commercially important. There are three types of fishing: 1) craft, 2) recreational, and 3) commercial. There was a cooperative that produced an average of 4,000-5,000 large oysters per month; it was also a tourist attraction.

A megaproject is being developed in the estuary zone, called "El Soldado de Cortés", that will consist of 12 hotels, 750 apartments, and 409 houses. The

area covered by this project will be 674 hectares, and the total investment is estimated as 90 million US\$ (infrastructure) and 20 million US\$ (superstructure). According to official estimates, the megaproject will generate 21,139 jobs (direct and indirect), and there will be 800,000 tourists in the year 2010, both nationals and foreigners.

This paper uses the economic valuation approach of Economic Valuation based on Multiple Alternative / Multiple Arrangement (MA/MA). There are eight types of values that can be taken: 1. Naturalistic Values: a) ecosystem value, and b) organism value, 2. Humanistic Values: c) social value; d) social preference value; e) individual value; f) individual preference value; g) price value in the market, and h) politically revealed value. In order to determine these values it was necessary to incorporate the externalities. Environmental

degradation externalities were implicit in the modifications made by the megaproject. In order to determine some values in the Table MA/MA, it was necessary to define the estuary as unchanged. Disturbed estuaries were defined as those places where natural service flows had been significantly modified or even terminated. It is then possible to explain the appropriate bases in order to calculate the estuaries' value together with the developed places.

This paper also suggests how recreational and tourism activities could be made more appropriate to the "Estero del Soldado" area. Since benefits were given an economic value, their influence and interaction with the estuary and mangroves could be defined as a system. As a result, the mangroves and the estuaries can be dynamically incorporated in the macro and micro economic processes of society.

### **An attempt of incorporation external variables to the economical/financial projects analysis with locational intents**

José Lamartine Tavora  
*University of Rio de Janeiro*  
Brazil

From the 1960's, when the ecological conscience starts to grow, the entities involved in the analysis about investment projects felt the necessity of incorporate to the economical/financial evaluation of these projects, external aspects of the economic theory (like: environmental impacts, sociological impacts, anthropological impacts, etc.). However, with the development of the researches, it was noticed several difficulties in analyzing impacts in so different unities. The question was: how to compare monetary units with the number of cut trees, with number of animals died, or with a culture/community extinction?

From these difficulties, various authors did several attempts in order to incorporate the ecological variables to the economical analysis, but, up to now, they haven't reached a definitive solution for this problem.

In our studies, we come to the conclusion that a economical/financial/environmental/sociological/anthropological projects analysis methodology would have to attend the planning and the investment requirements. From the investment point of view it is important not only one determinated project analysis, but also the evaluation among different investment alternatives, we mean, among different project concepts. Also, the feasibility of one special project may vary with its location. By other hand, from the planner are interested in identification of the best alternative for one determinated location, and also, if it is necessary, to act in order to decentralize the economical development, driving the new investments towards the needest regions in detriment of the saturated ones.

Thus, we are proposing a methodology that indicates the more interesting investment alternatives

by project and by location. The proposal methodology also permits the planner interference in several levels, like: to veto an alternative that puts in risk some live species, or culture, etc.; to penalize or benefit great, costs or small benefits, respectively; to give different weights to each one of the costs/benefits, according with their relative importance; and to interfere in projects localization.

The diverse stages of the methodology are:

1. benefits and costs matrix constructions,
2. distancial interferences,
3. ponderation and calculation of total benefits and costs by alternative,
4. benefit/costs relation liquid result calculation,
5. "liquid benefit by alternative x elementary location zone matrix building,
6. locational interference - final result.

### **Citizens, consumers and contingent valuation**

**Russell K. Blamey**  
*Australian National University*  
Australia

Some authors, such as Sagoff (1988), have argued that individuals will often respond to contingent valuation questions as citizens rather than consumers. The paper explores the distinction between such responses, arguing that citizen responses can differ to consumer responses in three, related but distinct, dimensions. Empirical evidence

concerning the relative influence of consumer and citizen factors is presented, and the options facing the researcher in case studies susceptible to citizen responses are explored. It is argued that contingent valuation research would benefit by adopting a more systemic, and social psychological, approach to the understanding of individual behavior.

### **Multicriteria evaluation in the framework of ecological economics: some epistemological considerations**

**Giuseppe Munda**  
*University of Catania*  
Italy

Environmental problems are very complex and characterized by scientific uncertainty. Any method trying to operationalize the concept of sustainable development is necessarily a second best approach.

In economic theory three main conflictual values can be identified: allocation, distribution and scale. In an operational framework, this means that an exhaustive analysis has to take into consideration efficiency criteria, ethical criteria and ecological criteria, thus a multidimensional paradigm is needed.

Ecological economics explicitly recognizes that economy-environment interactions are also characterized by significant institutional, political, cultural and social factors through which action is carried out. The use of several evaluation criteria is desirable. This implies that in the framework of ecological economics, the maximization and the weighting premises of Neo-Classical economics have also to be changed. This paper attempts to analyze in a critical way some essential aspects of the multiple criteria decision air (MCDA) methodology.

## Social and Ethical Dimensions of Ecological Economics

### Ecology and Economy in the Caribbean Basin

#### Panelists

1. Sam Cole: *Economic culture and ecology in a small Caribbean island: a short history of Aruba*
2. Ezra B. W. Zubrow: *The everglades project: environmental economic sustainability*
3. Clarissa Kimber: *The ecology of small plot farmers in Martinique*
4. Lydia Pulsipher:
5. Victoria Razak: *Land as commodity, land as identity*

Chair: Sam Cole, *State University of Buffalo, United States*

#### Economic culture and ecology in a small Caribbean island: a short history of Aruba

Sam Cole

*Dept. of Geography and Planning, University of Buffalo*  
United States

The paper will provide a historical review of economic, cultural and environmental changes in a small Caribbean island, and offer a structure for analyzing these temporal and systemic changes. Historically, the economies of the Caribbean islands like Aruba have lived through a succession of distinctive global epochs - mainly driven by sweeping political economic changes. In pre-Colombian times, for example, Aruba was on the fringes of the great civilizations of South America; during the European Age of conquest and colonialization, Aruba faced the civilizing forces of Spain, Britain, Holland and France; throughout much of present American Century the island has been dominated by a single major multi-national firm; and in the post-war era the island has faced the twin forces of neo-colonialism and global corporatism. In each of these epochs, the external actors have sought specific environmental resources - natural harbors, mineral and agricultural products, or simply "sun, sand and sea", the raw material of modern tourism. In each global age, the importance of all these resources has varied tremendously in a

manner dictated by the attitudes, products and technologies of the prevailing global powers.

Because of the acute way in which cultural and environmental change manifests itself is so apparent in small islands, they serve as a useful vehicle for analysis of the interface between global ecological and economic change in general. Most small islands have populations which have arrived with successive waves of economic change, usually driven by some new industry itself associated with a major new global commodity, often with devastating cultural and ecological consequences. For most islands in the Caribbean, this was sugar cane production and refining. In Aruba it was cattle ranching, gold mining and oil refining, and most recently, international tourism. In all cases, the economic restructuring this entailed, and the new immigration was driven by outside events, and the new immigrants selected by the prevailing colonial administration or economic concern, rather than the indigenous peoples themselves. The smallness of indigenous island

populations relative to the number of immigrants and visitors means that they are particularly vulnerable to external cultural forces. Often the economies and environment simply were redesigned to meet the needs of the metropolitan economies. In many cases the indigenous peoples were displaced or marginalized, ironically in some cases creating a new

wave of dependent migrants in the metropolitan economies. With present-day massive restructuring of the global economy with the rise of new industries such as tourism and telematics, closing their cultural and economic distance from the metropolitan societies, these impacts are forecast to accelerate.

### **The ecology of small-plot farmers in Martinique**

Clarissa Kimber  
*Geography Department, Texas A&M University*  
United States

Small-plot agriculture has a long history in Martinique. The Carib peoples who were on the island at the time of colonization by the French in the seventeenth century practices a slash-and burn agriculture of small-plots of mixed crops. The first colonists had small plots of indigo and tobacco and it was not until 35 years after the first colonizing episode that estate agriculture really took hold. French and African experiences. Recent efforts to expand estate agriculture has forced the small-plot farmer to move up-slope and on to more fragile environments. A typology of recent small plot farming types will be presented.

Strategies for the more sustainable agricultural exploitation of small plots by region will be outlined. Parameters in different models include the physical environmental factors of slope, soil, rainfall and temperature; social parameters of family size, gender, and community demography; economic factors of distance to local markets, linkages to world system, and externally applied economic restraints; and the technological factors. Forcing factors to be considered are changes in world markets, new agricultural methods including technological innovation; and possibilities for changes in political relations with France.

### **Land as commodity, land as identity**

Victoria M. Razak  
*Department of Anthropology, SUNNY Buffalo*  
United States

An understanding of the semantic relationships between the land, and the people its sustains, can help ecological economists avoid imposing models of development that will likely disrupt the cultural and economic relationships between them. This can be illustrated by looking at the effects of modernization and redevelopment on the indigenous people of the island of Aruba. Although the native-Arubians possess a highly stratified culture history shaped by centuries of colonization, immigration, and

environmental change, they also exhibit a strong sense of place and landedness, and a value for an Indian past and traditional way of life, construed in part through their relationship with the land. While travel is common between Aruba and the South American mainland, other Caribbean islands, and Europe, few natives leave permanently, valuing Aruba above all other places: "our beloved home, our venerated cradle".

Geographically the land is divided into semantically laden social spaces denoting social and ethnic origins, and where ownership signifies nativeness. The land it is also construed as an economic resource for agriculture, animal pasture, and tourism. Today, the island is caught up in a conflict between insider-outsider forces, and between cultural and economic needs, as it is being transformed away from its traditional role as

sanctuary, resource; and signifier of spirituality and nativeness, to one of commodity and economic resource. As it is reconstructed into urban, exclusive, and controlled space, the means to self-definition for the traditional rural populations has been disrupted as they are presented with a new set of alien and profane references, and rebounded spaces, through which they must redefine their identity.

## **Sustainable Agro-Ecosystems**

### **Equity Related to Trade**

#### **Panelists**

1. **Todd Litman:** *Total cost accounting in land transport planning: status of an emerging field*
2. **Henk L.M.Kox:** *An international? user pays' approach for LCD primary exports*
3. **S.J.Doherty:** *What's free about free trade: who's paying the bill?: tracking resources in external trade between rural and urban economies*
4. **John Gowdy:** *Trade and sustainability -lessons from History*
5. **Kariann Sokulsky:** *Operationalizing equity issues in environmental regulations*
6. **Ramón Pichs Madruga:** *Ecodevelopment and the "New World Order": the vicious circle between underdevelopment, the energy crisis, and environmental degradation*

**Chair:** **Sabine O'Hara, Rensselaer Polytechnic Institute, United States**

#### **Total cost accounting in land transport planning: status of an emerging field**

**Todd Litman**  
*British Columbia Ministry of Transportation and Highway  
Canada*

Transportation imposes significant economic, environmental and social costs, both directly through vehicle use, and indirectly through its effects on land use patterns and urban development. These costs are often ignored or given token consideration in roadway planning, leading to transport systems that are inefficient, damaging to the environment and inequitable. Growing concerns over the environmental and social impacts of transport have resulted in recent efforts to quantify these external costs and develop planning tools that can be used to optimize transport system economic efficiency and equity.

This presentation explores the meaning of "efficiency" and "equity" with respect to transportation, and the implications of significant external costs. Economic, environmental and social costs of transportation are discussed. Methods to quantify the external, non-market costs are considered, and monetized estimates of various costs are presented. Trends in transport that affect economic, environmental and social costs are discussed. Policies that can improve land transport efficiency, planning tools of optimizing transport investments, and recommendations to create a sustainable transportation system are described.



## **An international? user pays' approach for LCD primary exports**

Henk L. M. Kox  
*Free University*  
The Netherlands

To achieve internalization of environmental costs into the price of primary commodities it is necessary that previously uncounted environmental inputs, including pollution absorption, are valued and assigned to commodity production. In the absence of internalization of environmental costs, both domestic consumers and importing countries receive hidden environmental subsidies. The hidden environmental subsidy stems from not counting the depletion of natural capital (deterioration of environmental quality) caused by production of the commodities they consume. Governments of commodity-exporting countries have several instruments at their disposal to diminish ecological degradation associated with primary commodity production. They can, inter alia, use a regulations and standards approach, or economic (dis)incentive schemes to affect producers' technology choice decisions which are crucial for environmental externalities. Also, a policy of relieving information

constraints to sustainable commodity production, e.g. by extension services, sometimes has high payoffs. For commodities entering only the domestic markets these instruments are in principle sufficient for internalizing ecological production externalities, but effective implementation requires a sufficiently-developed countries. Several developing countries have already accomplished important results in this area.

The second part of the internalization job concerns commodities for the export market, and is much more difficult to accomplish. Individual exporting countries are confronted with the following dilemma. Either they disregard the hidden environmental subsidy, and thus accept a further welfare transfer in the form of an uncompensated degradation of the country's natural resource base. Or it is tried to pass on the concomitant cost price increase to the importing countries. If the

## **What's free about free trade: who's paying the bill? tracking resources in external trade between rural and urban economies**

S. J. Doherty  
*University of Florida, Gainesville*  
United States

This paper compares traditional economic measures of gross national product and monetary accounts of trade balance with energy-based measures of resource-use, trade and self-sufficiency in Mexico, Puerto Rico, Sweden and the U.S. It is shown that rural, developing nations generally export more total resources than is received in imports, even though their trade ledgers may be balanced in monetary terms. These same countries have a

greater proportion of their life support attributed to the unmonied services of their ecological support base. Developed nations have larger gross national products and a greater proportion of the energy and resources supporting national income is purchased, generally from less developed countries. Urban economies thus have less total resources supporting each unit of currency than rural countries whose economic base is still largely tied to the land.

These perspectives suggest that relative strengths of world currencies, as measured by international exchange rates, do not reflect the resource base supporting monetary accounts. Because of this, in an exchange with developing nations, the trade advantage often goes to the purchasing, urban national. Yet their actual buying power is less, measures as the relation of resource-use to gross economic activity -- suggesting that current indicators of economic strength are at least incomplete. This is shown to be especially true if countries export unprocessed resources such as ores, hydrocarbons or timber at current market prices, since the monetary value of the raw materials represents only the extraction costs and not the potential of the resource itself to stimulate the buyer's economy.

The *net balance* of total resources due to external trade is here considered the *surplus* that economies have to develop and invest. Because urban countries deliver less resources for every international dollar exchanged, and the fact that a greater proportion of their resource base is dependent on external trade where they have the advantage, developed nations predictably accumulate greater amounts of net resources. This surplus is often achieved at the expense of rural countries which are increasingly being forced to participate in the international market under the auspices of "free trade". The present global inequities in trade and living standards might at least be partially amended if monetary accounts were proportioned to a country's resource base, a valuation of real work contributions, which supports them.

### Trade and sustainability -lessons from History

John Gowdy  
*Rensselaer Polytechnic Institute*  
United States

The recent NAFTA debate focused attention on arguments by environmentalists that regionally based economies are more likely to promote environmental sustainability. Drawing on the work of Martinez-Alier, Norgaard, and Polanyi this paper examines this question focusing on the relationship between trade, biodiversity and social equity in indigenous non-market societies. It is well-known that indigenous cultures have a variety of social rules to limit the

adverse impacts of exchange and of the accumulation of wealth. In spite of extensive and far-reaching patterns of trade with other societies, indigenous cultures were able to maintain, until the incursion of market economies, native ecosystems. The role of cultural practices which inhibited the adverse effects of trade in these societies can be instructive in formulating policies for own society.

### Operationalizing equity issues in environmental regulations

Kariann Sokulsky  
*Texas Natural Resource Conservation Commission*  
United States

In 1993, the Texas Water Commission and Air Control Board (both are now the Texas Natural Resource Conservation Commission (TNRCC) created

the *Environmental Equity and Justice Task Force*. The Task Force was charged with identifying factors contributing to the inequitable distribution of

environmental hazards and providing recommendations which might remedy environmental inequities.

The Task Force represented a bold initiative in bringing equity considerations into the environmental regulatory framework. Additionally, the TNRCC is furthering the integration of equity consideration in environmental regulation in two ways. First, TNRCC

staff are evaluating a U.S. EPA Region 6 "equity" index for possible use in the TNRCC's permitting and enforcement activities. Secondly, the agency is conducting a comparative risk project to prioritize environmental problems based upon risks to human health, ecosystems, and socioeconomic welfare. Equity (or inequity) will be a factor in the prioritization of environmental problems.

### **Ecodevelopment and the "New World Order": the vicious circle between underdevelopment, the energy crisis, and environmental degradation**

Ramón Pichs Madruga

*Centro de Investigaciones de la Economía Mundial*  
Cuba

This paper shows the main results of recent research on "Environment and Development".

Since the middle of the 1980's, there has been an international debate on environment and development that has important political, economic, technological, social, environmental, and human dimensions.

This paper contributes with some general reflections about the "ecodevelopment" concept. It attempts to integrate the economic, ecologic, and social factors into a long term perspective, and attempts to outline an environmental dimension of the "New World Order".

A critical analysis is made of the "sustainable development" thesis and of the proposals that promote the establishment of a "green market" at an international level.

In addition, the causes and implications of the "greenhouse effect" are analyzed, with an emphasis on the consequences of this problem for developing countries. The relationship between energy and environment is examined, using the energy sector's input to the "greenhouse effect" as a base, thus

illuminating the vicious circle between development, environmental degradation, and the energy crisis in the developing countries.

Subsequent analysis reveals that development patterns followed by Northern countries, as well as underdevelopment and poverty conditions in the Southern countries, are not environmentally sustainable. However, there are aspects which, though related, must be examined separately in order to define the responsibility levels in the different countries, and thus create strategies which can meet global environmental challenges.

This paper shows the possible socioeconomic implications, for developing countries, of some of the economic mechanisms proposed in the United Nations Marco Convention on Climatic Change (i.e., environmental taxes and negotiable emission permits).

In addition, this paper presents some considerations about the environmental component of Cuba's socioeconomic programs, and identifies the main environmental challenges facing this Caribbean country now and in the near future.

## **Sustainable Agro-Ecosystems**

### **Water Resources & Energy Alternatives Management**

#### **Panelists**

1. Mark Cochran and Ramu Govindasamy: *An analysis of policy alternatives and market solutions to the water quality externalities from land applications of poultry litter*
2. A.B. Lumby: *Towards a sustainable energy strategy for South Africa: the feasibility of landfill gas as an alternative energy option*
3. Gary H. Wolff: *Financing environmental projects: landfill gas energy recovery at the Rio Azul landfill, San José metropolitan area, Costa Rica*
4. Elizabeth Brito, Michael Aller, Therese Fouda and Dieudonné Bitondo: *Evaluation of the long term sustainability of the Morong Dam and irrigated parcels in the extreme north of Cameroon, Africa*
5. Bruce Aylward, Jaime Echeverría and Raúl Solórzano: *Economic incentives for watershed protection*

**Chair:** Thomas Sterner & Milford Aguilar, *University of Gothenburg, Sweden*

#### **An analysis of policy alternatives and market solutions to the water quality externalities from land applications of poultry litter**

Mark J. Cochran and Ramu Govindasamy  
*University of Arkansas*  
United States

Non-point source pollution from agriculture is of growing concern in the United States. One area of increasing importance is the environmental loadings that occur from land applications of poultry litter. Arkansas is the nation's leading producer of poultry and recent concentration of the poultry industry has generated concerns about the water quality externalities that arise from the use of poultry litter as a fertilizer on nearby pastures.

Nitrates and fecal bacteria pose direct human health risks, while phosphorus loadings can result in eutrophication that may disrupt the large tourist industry in the Ozark Mountain region. Loadings of nitrates, phosphorus and bacteria all have different characteristics and pose challenges to management

designed to recycle nutrients without degrading the state's surface and groundwater resources. This study compares the relative trade-offs between the environmental loadings and the income that is generated by the fertilizer use of the litter for a variety of policy measures such as Best Management Practices, standards, Pigouvian taxes and tradeable permits. A non-linear programming model has been linked with a Geographic Information System (GIS) and a nutrient transport simulation model to maximize net income subject to probable constraints on the environmental loadings. Alternative policies to be examined include: alterations in the times and rates of litter applications; restrictions on further litter applications on soils with a high potential for erosion and/or high levels of soil phosphorus; taxes on litter

applied, acres of pasture or number of poultry houses; and a market for tradeable permits. An upper bound on the transactions costs that would be

economical for the marketable permits to succeed is identified.

### **Towards a sustainable energy strategy for South Africa: the feasibility of landfill gas as an alternative energy option**

**A. B. Lumby**  
*University of Natal*  
South Africa

The paper investigates South Africa's current energy policy which is characterised as inequitable, environmentally unfriendly and unsustainable. Against this background, consideration is given to the feasibility of exploiting landfill gas (LFG) as a relatively cost-effective, environmentally friendly and sustainable energy source.

Some of South Africa's most serious environmental problems arise from the long-established pattern of energy use. Given the limited supplies of water as an energy source, approximately 85% of South Africa's energy needs are met by coal, half of which is used by the government-controlled Electricity Supply Commission (ESKOM) to generate electricity. Not only is this energy policy based upon the exploitation of a non-renewable natural resource, and thus is unsustainable, it has also produced in South Africa some of the worst air

pollution regions in the world. Furthermore, some two-thirds of South Africa's population still do not have access to electricity in their homes.

An alternative energy option would be to make commercial use of LFG which contains some 50% methane, and as such constitutes an important, but as yet unexploited, energy source for South Africa. A comparative cost analysis between ESKOM's current charges (which ignores the exorbitant cost of extending ESKOM's electricity grid) and the current cost of exploiting LFG for commercial use reveals that LFG enjoys significantly lower costs per kWh for electricity generation, water-heating, space-heating and brickmaking. Furthermore, the commercial use of LFG would be sustainable and accessible to the majority of South Africa's population, and could be expected to generate much lower levels of environmental pollution.

### **Financing environmental projects: landfill gas energy recovery at the Río Azul landfill, San Jose metropolitan area, Costa Rica**

**Gary Wolff**  
*3E Engineering Fremont*  
United States

Landfill gas resource potential was field tested at the Río Azul landfill near San Jose, Costa Rica, in December 1991 as part of a feasibility study funded by the Energy Commission of the State of California, United States of America. At that time the Río Azul

landfill serviced 12 municipalities in the metropolitan area surrounding San Jose. Ten million cubic meters of refuse was available for energy recovery. Filling commenced in 1973 and was anticipated to terminate in December of 1992. The study was

performed on behalf of COCIM, the inter-municipal council which governed the landfill. It focused on landfill gas use as heat source at industries located near the landfill (concrete products manufacture, cement manufacture, clay brick manufacture, coffee bean drying), rather than electrical generation.

Energy recovery was found to be marginally feasible for most projects based on traditional economic measures. Benefit/cost ratios for various projects ranged from 0.8 to 1.7. Based on interest rates and loan terms customary in agency supported projects of this type, one energy recovery project (boiler retrofit at the concrete products factory) was deemed to be clearly feasible. Attempts to finance the project, however have not been successful to date. This paper both summarizes the project, and describes the practical obstacles which must be overcome to finance this type of environmentally and economically beneficial project.

Financing obstacles included:

- Project size (\$200.00 capital cost) was below

the threshold for international agency funding with favorable loan terms.

- Local interest rates and loan terms for a project of this type rendered the project infeasible in conventional economic calculations.
- Private investors with access to loan funds at lower interest rates encountered substantial political and institutional obstacles to project implementation.

In addition, environmental benefits of the project (health benefits from reduced landfill gas emissions; reduced exhaust gas emissions from fuel which would be replaced by landfill gas; reduction in emission of methane, a potent greenhouse gas; and reduced transport and indirect economic/environmental benefits of replacing an imported fuel with a locally generated fuel) are not accounted for in conventional economic analysis, but clearly make the project economically desirable from an ecological economics perspective.

### **Evaluation of the long term sustainability of the Mokong Dam and irrigated parcels, in the extreme north of Cameroon, Africa**

**Elizabeth Brito, Michael Allen, Therese Fouda and Dieudonné Bitondo  
Brazil**

The Mandara Mountains, in the extreme north region of Cameroon is a densely populated area with significant problems of shortage of water. Shower rains concentrate from July to August. After this period, water infiltrates very quickly and the rivers become dry. Since 1970, several small dams in the mountains have been built and water availability was improved. Based on these positive results, and considering the need to redistribute population density, in 1976 several other dams combined with irrigated parcels in the foothills were studied. The study focused mainly in the area around Maroua, the economic centre of the extreme north region. The Mokong dam and its 8500 hectares of irrigated parcels for sugar cane and vegetables was then the only viable one, from the economic point of view. The

dam, located 42 kms. west of Maroua, on the Mayo Tsanaga would allow for a reservoir of 114 millions m<sup>3</sup> from which 87.4 millions m<sup>3</sup> to be used for irrigation. The Mayo Tsanaga has its source in the Mandara Mountains and ends up in the Waza-Logone Floodplain. In 1991, the World Conservation Union (IUCN) and the Cameroon Government signed for the Development and Conservation Project of the Waza-Logone Region. This region, in the Extreme north of the country was seriously affected by the construction of the Waza dam and its 5500 hectares of irrigated parcels. The principal objective of the IUCN project is to design and implement a management plan to restore biological diversity and ensure a future system for sustainable resource management. One of the most important elements

of this projects is the hydrological rehabilitation of the floodplain. In this context, IUCN has decided to conduct an EIA of the Mokong dam to examine to what extent it would influence the Waza-Logone project. As the Mokong dam economic viability had been defined without taking in account environmental constraints and mitigation measures, in the EIA a broader sense of the "environment" was adopted, including not only biophysical and social impacts but the economic consequences, in the short and the long term as well. In this study, main impacts have been evaluated from the economical point of view.

All costs of mitigation measures have also been estimated. The project has then been submitted to a cost-benefit analysis, for a 20 year period. High costs of investments and mitigation measures associated with high costs of environmental losses contributed to neutralize some economic and social benefits. In the long term, environmental degradation provoked by the project would compromise its prosecution. Sustainable alternatives are to be identified to provide the necessary balance between the agricultural development needed and the environmental constraints of the region.

### **Economic incentives for watershed protection**

**Bruce Aylward, Jaime Echeverría and Raúl Solórzano**  
*Tropical Science Center*  
Costa Rica

Tropical moist forests provide a range of goods and services to society. Traditionally decisions regarding tropical forest land use have been made on the basis of major direct uses of forest land that generate local and national benefits. Typically, this has meant timber extraction and the conversion of forest to agricultural or livestock uses. In recent years increasing attention has been given to the important economic role non-market benefits may play in providing incentives for the conservation of tropical forests. A number of studies have explored the local, national and global benefits generated by non-timber forest products, ecotourism, pharmaceutical prospecting and carbon storage.

Another important ecological service that is also often cited as an economic justification of conservation activities is the watershed protection function provided by tropical forests. Watershed protection conserves soil and water yielding local and

national benefits. Nevertheless efforts to conserve watersheds are plagued by the difficult nature of the externalities involved. The off-site nature of many of the benefits of conservation activities makes both valuation and internalization of these externalities difficult, thereby preventing the development of "sustainable" watershed protection programs. This is even the case in areas where pristine, mountainous forests provide downstream national benefits to hydroelectricity and irrigation schemes. The establishment of incentive systems that solve market, policy and institutional failures impeding watershed protection in such areas remains a vexing problem for policy-makers, scientists and communities in developing countries. Drawing on the literature and an on-going collaborative research project in the Arenal region of Costa Rica this paper documents the contribution that economic analyses can make to the solutions of these problems.

## Sustainable Agro-Ecosystems

### The Role of the Media and Ecological Economics

#### Panelists

1. Tadeusz Burger and Andrzej Sadowski: *Ecological awareness*
2. Guido Fernández:
3. Flory Rodríguez:

Chair: Warner Villegas, *United States Information Service, United States*

#### Ecological awareness

Tadeusz Burger and Andrzej Sadowski  
*Institute of Sustainable Development*  
Poland

The "Ecological Awareness" report is a continuation of the "Ecological Awareness, Between Fear and Activity" report, published in 1992 by Institute for Sustainable Development. The aim of the research repeated in 1993 was verifying the 1992 results.

The research was commissioned by Public Opinion Research Centre in Warsaw. The number of respondents was similar, i.e. 1188, although the inner structure of this group was slightly different.

It turned out that there was a proecological group, making for one-third of the sample: therefore this group stands for one-third of Polish society. It is relatively more well off and better educated people, between 30 and 49 years of age, who are included in this group. They are inhabitants of large towns, declaring more often than others their participation in elections... It was again confirmed that the social structure of the group of people indifferent to ecological issues, had not changed: this group includes first of all older and relatively poorer people living mostly in villages. Over-representation of farmers is clearly discernible here. A particularly alarming fact is that the youngest of the respondents

(to 29 years of age) care less for ecological issues than they did in 1992.

These phenomena can be explained by economic conditions in which particular social groups live. The recession, or -in other words- structural transformation exerts an especially devastating effect upon older people (but also upon the younger: unemployment), and on inhabitants of areas which have not benefited much from urbanization. Ecological issues will always seem for these groups a lesser menace than everyday economic problems

Over 90% of the respondents gave positive answers when asked whether introducing ecological education to school curriculae was necessary, or whether they would be willing to sort their refuse and waste before getting rid of them (95%). Two-thirds of the respondents said that they would willingly pay additional taxes for improving environmental quality. Another striking fact is that the respondents were able to appraise (very aptly indeed) the quality of their local environment. This is connected with domination of one's local perspective. Although the respondents' faith in effectiveness of efforts of various authorities as far as improving environmental



quality is concerned, was generally low, it is municipal authorities which are expected to do most in his field.

The research proved again that mass media play a great part in making people perceive the range of ecological issues. When asked about most important

dangers of damage to their environment, the respondents first of all pointed at the ozone hole (63%); pollution of water was third (47%), and acid rains fourth (38%). Referring back to the name of the previous report, it is possible to say that fear is total and global, whereas countermeasures can be local. At least the respondents see it so.

## Sustainable Agro-Ecosystems

### Coastal and Marine Resources Management

#### Panelists

1. Donna Nickerson: *Trade-offs of coastal zone development in The Philippines*
2. Monica Hammer: *Linking proposal and socio-economic systems for sustainability: the case of Sweden's Baltic Sea fisheries*
3. Jessica Anderson: *Evaluation of the coastal resources on Mafia Island, Tanzania: an analysis from the indigenous resource users' perspective*

Chair: **Alejandro Yáñez, Universidad de Campeche, México**

#### Trade-offs of coastal zone development in The Philippines

Donna Nickerson  
Coastal Management Branch  
United States

Once only of local significance, mangrove areas in the Philippines are now an internally visible and highly valued resource, principally as a consequence of the emergence of the shrimp culture industry. This has resulted in a conflict with the traditional uses of the mangrove areas, as unmodified ecosystems, including firewood gathering, thatch material for homes (*Nypa* species) and mangrove poles for lumber and construction materials and nursery grounds for the local and commercial marine fisheries. The majority of marine and estuarine fishery species caught in tropical waters spend the juvenile stage in mangrove lagoons. In sum, mangrove forested areas in the Philippines have been steadily transferred from a common property resource, of benefit to a large number of people, to a private good, whose profits are narrowly channeled to the benefit of a select few.

This paper examines the trade offs between the traditional uses and the shrimp aquaculture industry in the Lingayan Gulf, Philippines, through the use of a multiple objective benefit analysis. As part of the economic valuation, the paper describes a population

dynamics model which illustrates the effect of the changes in the habitat (using mangrove hectares) to the population of a single mangrove-dependent species (*Leiognathidae*). The paper also observes the changes in biological diversity of the mangrove-dependent species with the loss of habitat. The paper then applies an assumed stock loss scenario to observe the net economic benefits of aquaculture development on an initial per hectare basis and subsequently to the Lingayan Gulf community as a whole. The analysis demonstrates the environmental impacts of mangrove area development and the consequent long-run economic and social implications to both the local area and to the country as a whole.

The multiple objective benefit analysis as used in this paper is most advantageous to show the consequences of choices not only in terms of net benefits which will indirectly affect the nation but most importantly, the net benefits and distributional effects which will directly affect the various groups examined. The issue of redistributional objectives or what real level of resource trade-off should be accepted in order to achieve any given level of

distribution is not discussed in this paper, nor does the analysis attempt to conclude with a set of value laden recommendations. The analysis simply identifies some of the more observable consequences and opportunities for such a social choice. In sum, it reduces the range within which the consequences of

alternative policies are based on value judgements alone. It will also point out the danger of relying too heavily on quantifiable economic benefits and costs in cases where serious problems of equity and social stability are at stake.

### **Linking ecological and socio-economic systems for sustainability - the case of Sweden's Baltic sea fisheries**

Monica Hammer  
*Stockholm University*  
Sweden

This case study focuses on Sweden's fisheries in the Baltic Sea. The extension of national fishing zones around Sweden in the late 1970's changed the conditions for Sweden's sea fisheries completely. Former fishing grounds in the North Sea were closed to Sweden's large west coast fleet and a shift towards the Baltic Sea as the most important fishing ground followed. A combination of ecological and socio-economic factors such as increased environmental degradation and increased fishing pressure to a large part due to overcapitalized fishing fleets have resulted in serious difficulties for the Baltic fisheries. In particular, the most important commercial fish species and also dominating top predator, the cod fish is now at a very depressed state and its future recovery may be at danger. The

current dominating management regime seem to have contributed to a loss of resilience in the ecosystem supporting fisheries. A survey made with resident fishermen along the Swedish Baltic coast indicates that large scale fishing and environmental degradation are seen as major threats to future fisheries by the fishermen. New management approaches better taking into account the ecological knowledge of local resource users are needed to be able to adapt to and respond to processes that contribute to the resilience of the Baltic Sea ecosystem. Further, the possibility of learning from local traditional management arrangements for a sustainable management of the fish resource and its life-supporting ecosystem is discussed.

### **Evaluation of the coastal resources on Mafia Island, Tanzania: An analysis from the indigenous resource users perspective**

Jessica Andersson  
*University of Gothenburg*  
Sweden

Depending on the definition used, there now exist between 700 and 1000 protected marine areas throughout the world, and the number is increasing. Further, in recent years there has been a shift in the design behind the establishment of such areas from single almost exclusive approach (i.e. preservation by

enclosure/exclusion), towards the development of multi-use, multi objective areas. This later approach is presently being applied to the proposed marine park around Mafia Island, Tanzania. The ultimate aim of this marine park is not simply preservation *per se* but to develop the area in an environmentally

sustainable manner which is favorable to the indigenous resource users. This implies, of course, that one of the main aims is to actively involve the indigenous users into the planning process, and to incorporate their skill and knowledge of the area and its resources into the implementation and management of the eventual park.

The present paper describes a study which investigates the perceptions of the various marine resource users on Mafia Island and its adjacent minor islands with regard to their resource related activities and the marine environment overall. Very few such socio-economic studies have been reported in the past, and little is known about the economic incentives governing the behavior of the indigenous resource users. Identifying the incentives behind destructive fishing methods and coral mining, for example is a first step toward the design of economic instruments for sounder environmental development. The present analysis was carried out in the framework of a traditional cost benefit analysis, but is solely from the point of view of the indigenous resource users. Accordingly the study identifies and attempts to quantify the use and non-use values of the benefits from implementing a marine park off

Mafia Island. The loss of the coral reefs, for example, could result in reduced fish production, increased coastal erosion and a deterioration in the aesthetic value of many coastal areas. The ability of the resource users to appropriate these wider values and to understand the interdependence between pristine reefs, non-degraded coastal areas, and the various economically important activities they participate in is crucial for the success of the park. The results show a high awareness of the ecological functions of the reefs and their subsequent economic importance among the resource users. Noticeable a difference is observed between the sites, in terms of use and perception of the resources, depending on the various bio-physical settings of the islands and villages surveyed. This is further manifested in differences of the socioeconomic structures implying a close relationship between the naturally inherited capital and the human -and cultural capital developed from it.

The results from this study clearly highlight the need for an interdisciplinary approach to such issues, and it is suggested that there should be a greater joint input of economic and ecological sciences into the management of marine reserves.

## Sustainable Agro-Ecosystems

### Developing Bio-physical Models for Resource Management with Special Application to Developing Countries

#### Panelists

1. Charles Hall: *Land, energy and the future of Costa Rican agriculture*
2. Mark T. Brown: *Energy, foreign trade and carrying capacity in developing countries*
3. James Jones, P.K.Thornton and G. Hoodegenboon: *Biophysical simulation models in ecological and economic research: applying aegis crop yield predictors to Latin America*
4. David Rossiter, Herman Cesar, Aart de Zeeuw, Rob Aalbers and Patrick von Laake: *Sustainability and the greenhouse effect: robustness analysis of the assimilation function*
5. Luis Arroyo:

**Chair:** Charles Hall, *State University of New York Syracuse, United States*

#### Land, energy and the future of Costa Rican agriculture

Charles A. S. Hall  
*State University of New York Syracuse*  
United States

I have developed, with associates, a synthetic computer model linked with a geographical model that allows one to examine the past, and project into the future, many independent but ultimately interdependent, demographic, environmental, agricultural and economic variables. The model includes a dynamic 3-dimensional central image that shows the area in undisturbed forest in Costa Rica at various time intervals from 1940 to 1983 together with 10 small graphs around the edge represent time series of various data. For example one of these

graphs shows the food calories needed to feed the growing population along with the calories generated in our simulation and that produced empirically (FAO Data). The model uses data from 1940 until 1990, and then allows the user to choose this model indicate that it is extremely difficult to continue to feed a continuously growing Costa Rican population into the next century because of a lack of high quality agricultural inputs that need to be imported to maintain high levels of per ha production.

## **Sustainability and the greenhouse effect: robustness analysis of the assimilation function**

David Rossiter, Herman Cesar, Aart de Zeeuw, Rob Aalbers and Patrick von Laake  
*Tilburg University*  
The Netherlands

Optimal control models with an environmental stock highlight the intertemporal trade-off between consumption and environmental quality. In these models it is generally assumed that the assimilation function of nature is linear (Nordhaus, 1982). At the same time there is quite some uncertainty on the general form of this function outside a specific range of values. In this paper, we look at different (non-linear) specifications of the assimilation function in

the case of the Greenhouse Effect. The optimal trajectories and the steady states are analyzed for the various functional forms. Slight variations in the assimilation function can result in a dramatic change in the steady state values. Besides, neither multiple equilibria nor the absence of steady states can be excluded. This will be shown with the use of simulations in a simple model of the Greenhouse Effect.

**Note:**

This session continues in  
Room Libertad  
7:00 - 11:00 pm

## **Sustainable Agro-Ecosystems**

### **The Political Economy of Gender, Environment and Development**

#### **Panelists**

1. Arturo Escobar: *Gender and ethnicity in new discourses on biodiversity*
2. Bina Agarwal: *Gender, environment and poverty: a critique of ecofeminism and an alternative perspective for analysis and action*
3. Wendy Harcourt: *A feminist alternative to greening economies*
4. Susan Hecht: *Gender, environment and development*

**Chair:** Fabiola Campillo, *Inter-American Institute for Cooperation on Agriculture, Colombia*

#### **Gender and ethnicity in new discourses on biodiversity**

Arturo Escobar

*Department of Anthropology, University of Massachusetts  
United States*

Recent debates on strategies for the conservation of biological diversity in tropical rainforest areas are giving rise to a series of relatively unprecedented actors -such as "biodiversity prospectors" and "gene hunters"- while at the same time reconstituting local communities and social movements as "stewards" of natural capital and "custodians" of the rainforest. While ethnicity

considerations and ethnic movements are increasingly allowed to participate in the discourse, women and gender issues have remained largely invisible. The paper reviews recent literature on the subject with the aim of visualizing possible ways of articulating gender and biodiversity. A case study of biodiversity in the Pacific Coast of Colombia is presented.

#### **Gender, environment and poverty: a critique of ecofeminism and an alternative perspective for analysis and action**

Bina Agarwal

*University of New Delhi  
India*

This paper examines the interlinks between gender, environment and poverty. Is women's relationship with the environmental distinct from that of men? If so, how and why? A growing literature

on ecofeminism in the West (with some Third World variants) conceptualizes the link mainly in ideological terms. The paper argues that the ecofeminist analysis fails to grapple with the factors which are

leading today both to environmental degradation and its particular implications for women, especially of poor households. Women are both victims of environmental degradation in quite gender-specific ways and significant actors in the process of environmental protection. It locates the gender-specificity of environmental effects and responses not just in how women and nature are conceptualized but equally in women's material reality: in the existing gender and class divisions of labor, property and power. In doing so, it also formulates an alternative perspective to ecofeminism, termed here as *feminist environmentalism*.

To concretize the discussion, the paper draws upon the experiences of India: the forms of environmental degradation, their causes, their class-gender effects, and the responses to them by the State and by ecology movements. In terms of causes it draws particular attention to the increasing appropriation by the State ("Statization") and by a few individuals ("privatization") of the country's natural resources, especially villages and forests.

This appropriation, in turn, has undermined pre-existing institutional arrangements of community resource use and management leading to resource degradation. Environmentally unfriendly bio-chemical technology in agriculture and high population growth have aggravated the degradation. The adverse effects of these processes are felt most acutely by the female members of poor households, in terms of additional work burdens, reduced incomes, poorer nutrition and health, and an erosion of women's social support systems and indigenous knowledge base. The intensity of these effects, however, varies a good deal by region, because of geographic variations in the extent of gender bias, the incidence of poverty, and the degree of environmental disadvantage. These regional differences are measured here through an index, which also helps identify the regions needing more immediate attention. The paper concludes by highlighting some priority issues for policy and action, and by emphasizing the need to define an agenda for economic development that is more class-gender participative and transformative, if it is to be environmentally sustaining.

## Gender, environment and development

Susanna Hecht  
*University of California, Los Angeles*  
United States

The focus on Non-Timber forest products has overloaded the social relations that prevail within them. Several misconceptions from the vote of women in the production processes and system management necessary for maintaining NTFP are widely prevalent. This paper reviews these

"\_\_\_\_\_ thesis" and, using field data describes the economic contributions of women in these systems.

The lack of attention to gender in analysts of NTFP systems in many ways minies the historic "invisibility" of women in agriculture.



## Sustainable Agro-Ecosystems

### Rural Development and Sustainable Land Use Policies

#### Panelists

1. Ruerd Ruben and Jan P. de Groot: *Rural development and sustainable land use policies*
2. Willem van Groenendaal: *Identifying energy efficiency opportunities in the manufacturing sector: the case of Java*
3. Antonieta Camacho: *Local participation in the national system of protected areas in Costa Rica: concerting means to overcome controversies at the Conservation Area (ACOSA) of the Osa Peninsula, Brunca Region*
4. Anders Elbom: *Soil conservation in Kenya*
5. J.C. Calvo Calvo, J.D. Vargas Giraldo and M.A. Aparicio Tovar: *The importance of agrarian practices regarding losses and gains of natural capital (fertile soil) in zones of a mediterranean climate*

Chair: Ruerd Ruben, *Wageningen Agricultural University, The Netherlands*  
Jan P. de Groot, *Free University Amsterdam, The Netherlands*

### Rural development and sustainable land use policies

Ruerd Ruben and Jan P. de Groot  
*Wageningen Agricultural University, Free University of Amsterdam*  
The Netherlands

The identification and promotion of sustainable agro-ecosystems is one of the main topics for the III ISEE conference. Several dimensions need to be distinguished to operationalize these concepts, both from the bio-physical viewpoint, as well as from the ecological economics viewpoint. A more integrated analysis requires a concrete linking of technical criteria on cropping systems and land use regimes, with socio-economic criteria on farmers incentives and institutional setting that enable a coherent treatment of technically appropriate, economically viable and socially acceptable rural development strategies.

Policies for sustainable land use received major attention in the report of the World Commission on Environment and Development (WCED) under the

presidency of G.H. Brundland, and occupy a prominent place in the Agenda 21 discussed during the UNCED conference in Rio de Janeiro. In April 1991, the Dutch Government called for a meeting with FAO to deal with "issues and perspectives in sustainable agriculture and rural development".

The operationalization of the concept of sustainable land use and agroecosystem management offers scope to a broad number of interpretations. The main issue refers to the economic and institutional environment that enable the rural population to use non-renewable natural resources to ensure the satisfaction of their current needs without compromising the ability of future generations to meet their needs. Related topics include a.o. the prospects for organic agriculture, incentive regimes

for reforestation and nature conservation, valuation of biodiversity, measures for erosion control and procedures for the reduction of risks. Although all these policies influence sustainability, their effects will become visible at different time and spatial scales.

Land use decisions are taken in practice by (groups of) farmers, responding to their own objectives, dealing with an environment which is partly influenced by local community rules, regional markets and infrastructural conditions, and national (macro) economic policies. The concern about sustainable land use can be addressed at different levels:

- how can different -sometimes even contradictory- rural/agricultural development objectives being made more compatible?
- which economic incentives are considered to be most suitable to facilitate farmers resource allocation towards more sustainable land use?

- what is the role of rural cooperation and institutional innovation for sustainable agricultural development?

Different available agro-technical options to improve sustainable land use can be evaluated against the background of the required adjustment in farm and/or cropping structures, as well as the necessary improvements in security of property rights of marketing channels. Although the level of economic development and the structure of agricultural production is somewhat different in each of the countries involved, the general question faced by all of them refers to:

*the identification of policy and institutional framework currently used to promote land use adjustments; the impact of these policies on sustainability; possible policy alternatives that may induce the adoption of sustainable land use practices by farmers themselves.*

### **Identifying energy efficiency opportunities in the manufacturing sector: the case of Java**

Willem J. H. van Groenendaal  
Tilburg University  
The Netherlands

Fossil fuels will remain the main form of energy for the next decades. Therefore increasing the energy efficiency of production processes in the manufacturing sector is one of the main possibilities to reduce emissions. This implies that the manufacturing sector should use the optimal fuel mix for its activities, and that links with the power sector have to be established to derive at a least cost

energy efficient solution. A method to determine the opportunities within the manufacturing sector for the use of cleaner fuels and the possibilities for cogeneration are discussed. The method is based on microeconomic considerations on the production process level and applied for the manufacturing sector of the island of Java.

**Local participation in the national system of protected areas  
Sistema Nacional de Areas Protegidas in Costa Rica:  
concerting means to overcome controversies at the conservation  
area of the Osa Peninsula, Brunca Region**

**Antonieta Camacho  
Universidad Nacional  
Costa Rica**

The National System of Protected Areas (SINAP) of Costa Rica, envisages the protected areas as multiple use territories, to administer biodiversity conservation and guarantee development. However, uneven changes in the use of the territory, rapid landscape and ecosystem transformations in buffer zones and subregional contexts are threatening the SINC and challenge long term sustainability. In the Osa Peninsular (OP) of Costa Rica ACOSA has been a focus of social, economic, political and environmental controversy. Regional and local development planning strategies conflict with the demands of local groups for accessing limited natural resources, democratic participation and developing survival strategies.

In regards to the model of participation in the SINAP, a central argument of this paper is that classical premises for rational participation has been renewed by a rhetoric of alternative self development, controlled by field professionals sponsored by a third party called non-profit-environmentally sound NGO's. These empowered external actors have the responsibility to facilitate, animate, manipulate, guide the participation of all others and also, to bridge environment/development interrelations. They have rebuild communication-power networks between local groups throughout excluding "conflicting demands", such as gold mining and logging, while specialized micro-sectoral coordinations are still a bureaucratic venture. The new scenarios of social action are framed in rational scientific approaches and managerial devices linked to the globalization of the environmental problems and innovative private forms of accumulation.

Over the past three decades the trends for local development translated symbolic meanings of the rural egalitarianism of the past, into modern strategies of development and political practices of

concealment. Thus, participation moved from a relative autonomy of local politics, self-reliant use of local resources and attention to local demands, to economic growth implementations concerned with public welfare. This also involved national political party cooptations and expanding formal bodies of consultation aiming at improving productive organizations through institutional channels. Such conditions facilitated the creation of the SINAC and the inclusion of environmental issues in national plans, although highly dependent on external economic flows.

That technically controlled process of peoples' participation for sustainable development segregated the SINAC from agrarian developments and contrast with the traditional roots of civil democracy. Costa Rican democracy evolved on the basis of favorable ecological conditions which provided a substantial material base for self-reliant socioeconomic basis of human reproduction, spatial integration and temporary resolution of social tensions.

Sustainable development implementations remain controversial. State action is not applied uniformly and has underestimated local initiatives by given priority to the economy of biodiversity and ecotourism, lead by mixed managements between public institutions and national-international NGO's which introduced new competitive technologies.

Still local people are often portrayed as the "destructive force, albeit capable of finding power on unwritten laws" and public bureaucracy viewed as a "complacent force", lacking of capacity to respond efficiently to policy innovations and privatization.

Such technically centralized provision to mobilize resource tend to disrupt the sense of locale, exclude genuine initiatives, block the organic capacity of local

people to envisage endogenous alternatives to improve their livelihoods and reduces the prospects for the future.

## Soil conservation in Kenya

Anders Ekbohm  
Göteborg University  
Sweden

This paper analyzes economic aspects of Kenya's nationwide soil conservation programme. The paper is organized into three parts: the first part structures the issues soil erosion and soil conservation by using the Logical Framework Approach; the second part analyzes the economics of two different implementation strategies for soil conservation, and the third part discusses the problem of soil erosion from a common resource management perspective.

The Government of Kenya launched in 1974 a vigorous soil conservation scheme against the nation's largest, officially recognized obstacle to development - soil erosion. Initially, a small-scale pilot-project was established which currently has developed into a nationwide scheme, affecting approximately 1.1 million households and is internationally renowned as the "Kenyan model" for soil conservation. In an organizational analysis of the programme we use the Logical Framework Approach. It is a practical planning tool for adequate problem analysis, and coherent structuring of causes and effects of a focal problem (soil erosion), which helps identify activities, inputs, immediate and long-term objectives to reverse the problem. The analysis concludes that there are considerable inconsistencies in the programme's design, with regards to problem analysis, measures as well as evaluation criteria. Important economic and institutional aspects of the focal problem have been disregarded, such as smallholders' property rights legislation, households' and communities resource management regimes, and macro-economic and sectoral policies. It has had important, negative implications for the programme's performance.

In 1987 the programme adopted the catchment approach as a new implementation strategy for soil conservation. It urges farmers to practice soil conservation communally, based on a coherent plan in a hydrologically homogeneous area. We empirically evaluate the relative profitability of the two implementation strategies, based on a case study in Western Kenya. By applying a social cost-benefit analysis, we conclude that site A (the area practicing the catchment approach). Net Present Value of the programme in site A is 114 Million KShs, whereas it is 54 Million Kshs in site B. The figures are derived from a base case which represents the most likely scenario of costs and benefits accrued in each site/approach, including a 25 years time horizon, border price adjustments on crops and shadow rates on labor. In a sensitivity analysis we allow crucial variables to change. Irrespective of change (positively or negatively) within our limits of discount rates of 0% and 10%, all simulations show a firm net social benefit in both sites, and in the "worst case" using 10% discount rate, the costs in site B are allowed to increase by 19% before running into net social loss.

The transition from the previously practiced single-farm approach was justified on grounds of considerable off-farm externalities and low adoption among farmers. Since fertile top-soil is a volatile economic good and through erosion implies considerable social distress and decreasing yields. We analyze conservation in the framework of optimal management of common pool resources. Using design principles (argued to be essential) for sustainable use of common resources as a point of departure, we summarize qualitatively the potentials of each implementation strategy to attain the

programme's objectives of increased employment and yields, and sustainable prevention of soil erosion.

Based on our results we concluded that soil conservation based on communal management in the

catchment approach is an economically and institutionally better regime than individually practiced soil conservation confined to single farms. The results have important policy implications.

### **The importance of agrarian practices regarding losses and gains of natural capital (fertile soil) in zones of a mediterranean climate**

Juan de la Cruz Calvo Calvo, Juan de Dios Vargas Giraldo and Miguel Angel Aparicio Tovar  
*University of Extremadura*  
Spain

The agrarian system around the mediterranean basin is more sustainable than that situated in the damper climate zones with their nutritive deficiencies, or in the drier climate zones with their excess of salt. The correction of nutritive balance with organic and mineral fertilization avoids the itinerancy characteristic of the damp and hot agriculture of the tropics, and the correction of salt balance by drainage and drying thus avoiding desert nomadism.

This paper evaluates how the management of mediterranean agroforensic systems of dehesas can be sustainable or not from a pedological point of view.

The dehesas's importance not only as a system

that produces economic goods and services, but also as a system that preserves and produces environmental goods and services will be examined. The study will be carried out on how the dehesa is a productive system that generates fertile soil. Evaluations will be made both quantitatively and qualitatively on the soil generated and formed annually by animal excrements in free pasture and the dry matter given by herbaceous and shrub masses. Finally, from an economic point of view, the chemical fertility given by manure on the soil will be determined.

With that, we shall present the economic and accountancy study of the humus and its components.

## Sustainable Agro-Ecosystems

Satisfying the demand of a growing human population for food will depend upon reconciling agricultural production with increasingly stressed ecosystems. This theme explores the key components involved in adjusting how human populations secure food so that the impacts are modified to maintain ecosystem integrity and health.

### Panelists

1. Ariel Lugo, *Institute of Tropical Forestry, Puerto Rico*
2. Gilberto Gallopín, *Centro Internacional de Agricultura Tropical, Colombia*
3. Miguel Altieri, *University of California, United States*

**Chair:** Robert Costanza, *University of Maryland, United States*

### Ecosystem management for conserving biodiversity and sustaining development

Ariel E. Lugo  
*Forest Service International Institute of Tropical Forestry*  
United States

Ecosystem Management is both a challenge and an opportunity of unprecedented dimensions. The challenge is ingrained in the intention of managing whole ecosystems at scales of space and time that exceed familiar stand compartments. The opportunity rests in participating in the most fundamental change to date in the way modern society relates to forest lands. The decisions that we are making at the end of the 20th century are analogous in significance to those made by our predecessors at the beginning of the century. Our task is to develop the operational know how which will be used by others to eventually manage the whole Earth. To succeed, we must take an ecological and humanistic approach; apply the best science and technology we can muster; form and collaborate with partnerships within and without science; and be up front with the general public, our main clients. *Ecosystem management is using holistic analysis to manage lands and water for products, services and conservation of biodiversity.* The success of Ecosystem Management depends on the type of analysis and the level of popular

involvement that occur before execution of management actions. The influence of science in thinking, planning and execution of management actions in the field. Four main areas with rapidly evolving paradigms of thought are driving Ecosystem Management. These are 1. the perception of a rapidly changing world, 2. the notion of spatial and temporal hierarchies, 3. the resiliency of ecosystems, and 4. the human dimension of management, including humans as agents of environmental change. Examples of these paradigms are:

- a non-steady state concept of the ecosystem (as opposed to a focus on climax or balanced ecosystems);
- managing from a resiliency (as opposed to stability) point of view;
- considering disturbance an integral part of ecosystems, required for their maintenance (as opposed to suppressing catastrophic factors or ignoring them);
- considering past land-use legacies, all species, and the dead mass (necromass) of ecosystems,

as opposed to focusing only on the present state of the site, and the live components of a few species and populations.

- Focusing greater attention on the connections within and between ecosystems, particularly the land/water/atmosphere interfaces;
- considering all time and spatial scales (as opposed to only focusing on short-term and the small geographic scale);
- maintaining a global, as opposed to a local perspective, even when managing at small scales;
- restoring whole ecosystems as opposed to only rehabilitating land and water productivity;
- considering social issues and problems as opposed to managing in isolation from social and cultural imperatives.

### **Technological change, and agro-ecosystem sustainability**

Gilberto Gallopín  
*Centro Internacional de Agricultura Tropical*  
Colombia

Agro-ecosystems are described as a particular case of socio-ecological system, and a set of basic attributes underlying their sustainability are proposed.

Intensity and quality dimensions are used to characterize technology in terms of its ecological and economic implications upon agro-ecosystems.

The basic traits, and the potential direct and indirect environmental impacts of the unfolding techno-economic revolution, upon the sustainability of the ecosystem in the North and the South are discussed.

For the case of Latin America, the results of

simulation modelling of current trends in the major agro-ecosystems suggest widespread ecological degradation associated with current and anticipated patterns of land use. The simulations indicate that a more sustainable path, however, is ecologically and technologically possible. Its implementation will require a strong commitment to promote active and continued environmental policies, integrated within new social and economic ones, and strongly supported by science and technology.

Strategic guidelines for science and technology for sustainable agro-ecosystem development policies in Latin America are suggested, which may also have global applicability.

### **Sustainable agro-ecosystems**

Miguel Altieri  
*University of California*  
United States

One of the few areas in which the concept of sustainable development can be "crystallized" or "become execute" is in the realm of agricultural development. Many examples of rural development

projects run by NGOs in Latin America which integrate local development and economic viability are described.

The question of when does agriculture become sustainable is addressed with case studies, in Latin America, where various environmental and economic indicators are used to evaluate performance and input

of proposed agro-ecological technologies. Natural resource accounting as well as rapid rural appraisal technologies have been used for the analysis of agro-ecosystems.



## Creating the Institutional Setting for Sustainable Development

Efforts to achieve sustainability can be helped or hindered by the institutional context in which they operate. This theme explores ways in which institutions at all levels -and the policies they dictate- can foster the integration of ecological economics at all scales.

### Panelists

1. Johannes Opschoor, *Free University of Amsterdam, Netherlands*
2. Alvaro Umaña, *Instituto Centroamericano de Administración de Empresas, Costa Rica*

**Chair:** Robert Costanza, *University of Maryland, United States*

### Creating the institutional setting for sustainability

Johannes B. Opschoor  
*Free University of Amsterdam*  
Netherlands

Sustainability is a concept that is related to fairness or equity (especially, though not exclusively, in an intertemporal or intergenerational setting) and to the integrity of natural systems and processes (at least from an instrumental perspective and -according to many: also from an ecocentric/intrinsic perspective). Though there are some links with the concept of efficiency or resource allocation optimally, these are less well defined. The predominant institutional structures that influence decision making on resource allocation (i.e. market forces and the market mechanism) are basically geared towards efficiency almost at the exclusion of other values such as sustainability and equity. The predominance of these institutions has even tended to increase over the past decades, especially since 1989. On the other hand, the enhanced significance of market mechanisms and market forces is one of the realities countries and people are facing, both at the (sub)national and international level. At the latter level, recent developments related to world trade arrangements illustrate this (Uruguay Round). The presentation will outline these tendencies and describe the UNCED and Post-UNCED positions on them, as well as the institutional developments at the

international level since June 1992; at the (sub)national level, some relevant elements of structural adjustment and economic transformation will also be discussed.

Against this background, the presentation will try to analyse which aspects of these tendencies are favourable to sustainability and -more especially- to unsustainability. Aspects of failure will be discussed, as well as the double-edged nature of the inherent forces of economic growth in a (world)market economy.

This leads to conclusions in terms of:

- Areas where a deliberate and directed harnessing of market forces could be in the interest of both efficiency (welfare) and sustainability, and under what institutional conditions such harnessing might be undertaken beneficially;
- Areas where complementary institutions must be developed to curb or mitigate unsustainable aspects of economic processes operating in a market dominated context;

● Perspectives on the types of additional institutions needed to move towards sustainable economies and a sustainable global economic system.

Where possible these three points will be illustrated with practical and operational examples of such institutions.

## Creating the Institutional Setting for Sustainability

### Modeling the Ecological Economic Determinants of Human Carrying Capacity

#### Panelists

1. Cutler Cleveland: *The energy required to grow food in industrial agriculture: can technical change overcome resource degradation?*
2. Robert K. Kaufmann: *The physical and social determinates for corn yield: implications for climate changes and economic development*
3. Rob Aalbers, Herman Cesar and Aart de Zeeuw: *Extinction of the human race: doom-mongering of reality?*
4. Stein T. Holden: *A model of transmigrants in a rain forest setting: adaptive strategies, living conditions and environmental consequences and feedbacks*
5. Robert Costanza:
6. Faye Duchin:
7. Gilberto Gallopín:
8. Harold Glasser: *Is the term "ecological economics" a bit of an oxymoron? Some pressing issues facing the field*
9. John Peet:

**Chair:** Albert Steenge, *University of Twente, The Netherlands*

#### The energy required to grow food in industrial agriculture: can technical change overcome resource degradation?

Cutler J. Cleveland  
*Boston University*  
United States

The dramatic increase in global food production is driven by improvements in agronomic and plant breeding technologies and by the use of large quantities of fossil fuel and electricity per hectare of cultivated land. Industrial agriculture also tends to degrade its natural resource base, leading to apocalyptic visions of the impacts of soil erosion and other forms of degradation that date to the Dust Bowl era of the 1930's. Thus, an important aspect of future food production is the degree to which resource degradation increases the energy required to grow food and the degree to which technical change can offset that depletion and develop substitutes for

our dependence on fossil fuels. This analysis uses new and more consistent data on energy use in U.S. agriculture to assess these and other forces that shape the productivity of energy use from 1950 to 1990. The results of an econometric model indicate that changes in the quantity of energy used per hectare, the average size of farms, the quantity of land harvested, the ratio of livestock to crop production, weather, and the price of energy also influence the productivity of energy use (in order of decreasing importance). The model is used to test explicitly for the effects of resource degradation and technical change on energy productivity. The results

indicate that the effects of soil erosion and other forms of resource degradation have not diminished the productivity of energy use in the U.S. farm sector, presumably due to advances in technology and behavioral responses on the part of farmers.

Care should be exercised in extrapolating the apparent success of technical change and cumulative learning in U.S. agriculture to developing nations

because this analysis does not explicitly represent the biological and physical conditions that technical change and soil erosion have "operated" on in the U.S. The same quantity of cumulative soil erosion or the same rate of technical change in a region with less topsoil or less fertile soil than the U.S. could produce depletion effects that are stronger than technological advances.

### **The physical and social determinants of corn yield: implications for climate changes and economic development**

**Robert Kaufmann**  
*Boston University*  
United States

The paper describes a new method for integrating the physical and economic determinants of corn yield. The effect of physical determinants is estimated by calculating climatic conditions during phenological stages of development. The effect of social determinants is estimated by including variables that represent the economic climate (expected prices, government programs), the technical environment (e.g. machinery used), and the demographic environment (average age of farmers).

The results indicate that the physical environment accounts for about 33 percent of the variation in yield while the social environment account for 66 percent of the variation. The importance of the social determinants indicates that behavioral and technical adaptations by farmers can be used to offset some of the negative effects of climate change and that great care must be used transplanting agricultural systems from developed to developing nations.

### **Extinction of the human race: doom-mongering or reality?**

**Rob Aalbers, Herman Cesas, Aart de Zeeuw**  
*Tilburg University*  
The Netherlands

Traditionally, economists have modelled the environment as any other good. In their models there is basically no difference in the way a consumer treats an ordinary consumption good, say beer, and the environment. This view might be correct when we look at the environment as being natural capital or as having an amenity value. In these cases a trade-off can be made between the enhanced

consumption opportunities and the value of the environment (be it amenity or productivity value). However, this type of analysis fails to consider another feature of the environment, that of a life-support system. The crucial point here is, that this feature has no direct economic value: it is neither used in production nor can it be valued for its amenity function. The only thing we (economists)

can say about it, is that when the life support system is intact, it is possible to produce and to consume and when it is not intact, this is not possible.

To evaluate this problem we consider a model in which the environmental functions are considered separately. As an example, we take the problem of acidification. The environmental sub-model on which can be decided whether or not the life support system is intact, is based on a model used by biologists to describe soil-acidification. Consumption is considered to be polluting. The basic trade-off the consumer has to make is whether or not he will live sustainably. If he chooses to live sustainably, he has to make certain that the life-support system does not break down, i.e. he has to leave a minimum amount of environmental capital intact. This will put certain limits on consumption. If, on the other hand, he chooses to live unsustainably, he does not have to

bother about the environment at all: in a finite time he will destroy the life support system and as a consequence of that he will also die. In the mean time his consumption pattern does not have to change much (if it has to change at all).

The central question of the paper is under what conditions of the utility and/or production function does the consumer choose a sustainable consumption plan? In other words, under what conditions does the consumer prefer to consume relatively much during a finite time period (unsustainable option) versus consuming relatively little during (in principle) an infinite time period (sustainable option). Calibration of the biological sub-model will give us some idea whether optimal plans are sustainable or not. Finally we consider the role of taxes. Is it possible for taxes to change consumer behaviour from being unsustainable to sustainable?

### **A model of transmigrants in a rain forest setting: adaptive strategies, living conditions and environmental consequences and feedbacks**

Sten T. Holden  
*Agricultural University of Norway*  
Norway

In order to analyze and simulate adaptive strategies of transmigrants from Java in a rain forest setting in Sumatra, to evaluate their living conditions and their impact on and interaction with the new environment, recursive programming models of typical households were developed. Under conditions with limited experience, imperfect information and poor living conditions, recursive programming proved to be a good tool giving solutions close to the real world situation. Transmigrants in the area experienced severe land degradation and pest problems and were forced to go off-farm for various activities in order to survive. These involved utilizing

surrounding rain forest resources as well as work on neighboring plantations. A large proportion of the transmigrants also returned to Java. The models predict that work on neighboring plantations and swiddening in the surrounding rain forest are the best strategies for households unable to find other employment or unable to return to Java. These strategies will, however, only give income levels close to or below the subsistence level as it is defined in Indonesia. Assistance from outside is required to improve their living conditions, to reduce their damage to the surrounding rain forests, and to develop sustainable farming systems in the area.

## Is the term "ecological economics" a bit of an oxymoron? Some pressing issues facing the field

Harold Glasser  
*University of California*  
United States

Marilyn Waring has criticized the term "ecological-economics" as being "just a play with words" (1994:160). She contends that the emphasis upon conventional economic tools, albeit with a chorus of caveats, almost represents a contradiction in terms. At the time of our third international meeting it's certainly appropriate to ask if our effort represent an insignificant, incremental "refinement" to traditional economics, or a much more significant attempt to make tools for evaluating policies and projects consistent with both ecological realities and moral considerations? I argue that our efforts certainly represent a step in the right direction, but as long as the predominant emphasis is placed on the compatibilities between development and growth (as outlined in the Brundtland Commission's report) we will not be able to come to terms with the inherent contradictions. A wide range of values enter into our decision processes, some quantifiable and some qualitative. Often these values conflict. Ecological economists need to accept these realities to address issues like: conflicts between human population and wilderness, theoretical compensation vs. actual compensation, limitations in our ability to manage natural systems, and lack of equity. We need to develop approaches that allow us to address multiple senses of value, lack of fungibility between these senses of value, limits to substitution, and the inevitable conflicts in goals that are likely to arise. We can certainly respond to these issues, but it will take an active commitment to the primacy of ethics and values in policy as well as a similar commitment

to make our actions, as well as our tools for analysis and evaluation, consistent with these values. I outline a series of criteria to re-evaluate our tools and help generate consistency between values, ecological exigencies, analytic and axiomatic realities, and pragmatic policy considerations.

The corporate leaders represent companies registered at the Stock Exchange in each country, and the survey thereby covers various sectors. Also, leaders at different levels within each organization have been questioned, i.e. Chairman of the Board, CEO, Line Manager and Environmental Manager. The purpose here is to examine what differences in opinions and knowledge there are, that could be referred to various positions in the company.

The results from the analysis are interesting both for the firms in their strategic planning, and for the government in their development of environmental legislation/policy. They will also be useful in education, in defining research topics, and in constructing indicators for sustainable development.

The paper will also discuss methodological issues in developing the Environmental Business Barometer. The purpose is to discuss how to obtain reliable data, how to standardize the survey, how to present the information in the most efficient way (for example through aggregated indexes, etc.).

**Note:**

This session continues  
Room Las Américas  
7:00 pm

## Creating the Institutional Setting for Sustainability

### Biodiversity & Development: Restoration

#### Panelists

1. Luca Tacconi and Jeff Bennett: *Participatory biodiversity conservation in Vanuatu*
2. David M. Rivas: *Economic development in protected areas: the case of national parks in Spain*
3. Bettina von Hagen: *Reconciling development and conservation: conservation-based development in the coastal temperate rain forests of North America*
4. Thomas Schlichter, et. al.: *Production systems and desertification in Northern Patagonia, Argentina*
5. Philippe Crabbé: *Ecosystem recovery on the St. Lawrence*

**Chair:** Jorge Jiménez, *Instituto Nacional de Biodiversidad, Costa Rica*  
Tania Ammour, *Centro Agronómico Tropical de Investigación y Enseñanza, Brasil*

### Participatory biodiversity conservation in Vanuatu

Luca Tacconi and Jeff Benett  
*The University of New South Wales*  
Australia

The conservation of biodiversity has implications both for the intergenerational and intragenerational distribution of resources. Tacconi and Bennett (1993) have argued that the establishment of protected areas designed to conserve biodiversity, can contribute to the achievement of intergenerational equity. However, the economic impact on the people currently living in, or close to, these protected areas cannot be overlooked. A satisfactory solution to the intragenerational distribution of resources is a prerequisite for the successful implementation of

biodiversity conservation projects. The paper reports on a case study from Vanuatu to illustrate these issues. In Vanuatu, a participatory approach to conservation has led to the establishment of the first forest reserve area of the country. The case study presented in the paper is used to support the argument that institutional economics and the "people centred" approach to development hold important lessons for ecological economists. Ecological economics should heed these elements if it is to be successful in yielding useful policy results.

## **Economic development in protected areas: the case of national parks in Spain**

**David M. Rivas**  
*Universidad Autónoma de Madrid*  
Spain

The vast territory of Spain is very different from its tiny policy for conservation. Fortunately, the main direction of this policy seems to be changing. Spain has reached a middle level of development, albeit with some economic backwardness in wide regions, usually the ones with a noteworthy natural heritage.

Spain's National Parks policy has to take into account that many of the ecosystems have been under long-term human influence. These influences have, in fact, contributed to make these ecosystems what they are today. As a result, Spain cannot develop a pure conservation policy, but has to mold one that can include cultural, social, and economic elements.

The enlargement of the Parks network that the State seeks to carry out is not in harmony with

interests and prejudices of some inhabitants in these areas. In addition, some political and economic pressure groups point out that the protection of a natural area affects productive sectors and impoverishes the population, since the latter will likely be expelled from the zone.

I have conducted studies in several parks, comparing their socioeconomic characteristics and designing models about their systemic links. As a result, I can argue that, in Spain's case, economic development and social welfare are better in the protected zones than in the unprotected zones, especially when the population is located inside the Park. In addition, the emigration rates in the protected zones are significantly lower than in unprotected zones with similar socioeconomic characteristics.

## **Reconciling development and conservation: conservation-based development in the coastal temperate rain forest of North America**

**Bettina von Hagen**  
*Ecotrust*  
United States

Ecotrust, a private, not-for-profit organization, is attempting to create functioning examples of sustainable development in the coastal temperate rain forests of North America. This paper will describe and analyze the philosophical underpinnings and applications of Ecotrust's approach to conservation and development. First, the failures of traditional approaches to conservation and development will be examined, and conservation-based development will be proposed as the rational alternative. Barriers to conservation-based development, such as lack of

access to capital, markets and technical resources and perverse measurement and incentive systems will be identified and discussed. The community will be identified as the natural and appropriate decision-making unit and Ecotrust's strategic focus on local capacity-building will be described.

The proposed strategies, programs and institutions which will address the barriers noted above will be described. The development strategy includes providing resources for entrepreneurs whose



business activities also contribute to ecosystem health. The tools for this development strategy include a commercial bank, a high-risk loan fund for emerging eco-entrepreneurs, venture capital, and technical assistance programs and brokering services to overcome the remoteness of rural communities. Programs also include the development of accounting and monitoring systems which reflect the underlying condition of natural and human

capital. Conservation and ecosystem restoration are also significant activities as functioning, intact ecosystems are the cornerstones of both economic and ecological health. The paper will draw on theoretical and applied research on sustainable community development and on Ecotrust's experience in community development and conservation in four coastal temperate rain forest communities.

### Ecosystem recovery on the St. Lawrence

Philippe Crabbé  
University of Ottawa  
Canada

This 3 year, two and a quarter million dollar project aims at rehabilitating the Cornwall-Lake St. Francis section of the St. Lawrence River in North America in collaboration with its local communities. It involves about 45 scientists from various universities in Canada, from all disciplines divided among 9 teams going from hydrology and chemistry to medicine, psychology and ethics. Public policy, interdisciplinarity and training of young environmental scientists are the main goals of this project funded through the Canadian Department of the Environment. This river is the fourth largest in the world and connects the Great-Lakes (10% of the freshwater reserve of the world) to the Atlantic Ocean. While sustaining abundant commercial fisheries until the middle of the nineteenth century, it is now highly polluted by all kinds of industrial activities, especially by pulp and paper mills. The ecosystem selected has the following features which make it ideal for interdisciplinary study. It is located downstream from a dam which regulates the level of the St. Lawrence River. It has been modified to allow navigation on a seaway used by heavy boats which transport grain and ore from the heart of Canada to the ocean. It has heavy polluting industries (foundries, pulp and paper textiles aluminum, etc.) on both sides of the river. It contains several rapidly disappearing wetlands including one which is protected by the Ramsar Convention because the ecosystem is located on the migrating path of the Canada Goose. The Canada-

U.S. East-West border divides it in the middle, where a reserve of Native Indians, the Mohawks live on several islands. Two Canada provinces; Quebec and Ontario, divide the ecosystem and the Indian reserve North-South. In Quebec, one speaks mainly French. In Ontario, one speaks mainly English. Natives speak mainly English. The International Joint Commission which is an international body responsible for the management of boundary waters between Canada and the United States has adopted an ecosystem approach to water quality rehabilitation; however, it requires consent from both countries for any action. Natives and numerous sport fishermen are unable to eat the fish because it is too contaminated by PCB's and heavy metals. There is evidence that the cancer rate in the ecosystem is higher than elsewhere in Canada. The region including the seaway is in economic decline which makes any environmental improvement costly in terms of remaining jobs. Natives, taking advantage of straddling the border are heavily into smuggling tobacco and alcohol and perhaps heavier drugs claiming immunity denied by the Government of Canada - by invoking an old international treaty between Canada and the United States. Natives are torn between their traditional values and way of life, which they can no longer sustain because of the degradation of their natural environment, and the get-rich-quick mentality which fuels gambling and smuggling activities. The Canadian government is sympathetic to Natives, fearing adverse international publicity and being

anxious to obtain a settlement on native self-government. Using an ecological function approach to ecosystem characterization, we identify environmental quality parameters (physical, socio-economic, health) and map them into human values using a reconstruction of the pristine state of the river 7,000 years ago when the natives arrived on its

shores, as a benchmark. The purpose of our project is the sustainable re-development of the ecosystem. The local communities (including the native population) have identified an environmental institute devoted to the comparative study of large rivers as being a part of this strategy.

## Creating the Institutional Setting for Sustainability

### Resiliency in Natural and Economic Systems

#### Panelists

1. Carl Folke: *Linking social and ecological systems for resilience and sustainability*
2. Doris Capistrano: *Ecological economics and common property issues in Bangladesh's openwater and floodplains fisheries*
3. Mark A. Ridgley: *Global warming, policy negotiation and the issues of allocation, distribution and scale*
4. Thomas Zylicz: *Will new property right regimes in Central and Eastern Europe serve nature conservation purposes*

**Chair:** Susan Hanna, *Oregon State University, United States*

#### Linking social and ecological systems for resilience and sustainability

Carl Folke  
*The Royal Swedish Academy of Sciences*  
Sweden

The general objective is to investigate how the resilience of certain selected ecosystems can be improved by learning from traditional and newly-emergent social/ecological systems, and how potential new principles derived from such studies can be used to determine whether degraded ecosystems can be restored to generate a sustainable flow of ecological services. Through case studies from various parts of the world the paper addresses 1) how the local social system manages ecosystem processes and species/populations; 2) how the local system maintains ecosystem resilience in the face of perturbations; and 3) the combination of property

rights arrangements, institutions, and knowledge systems which accomplish the above successfully. The research includes the identification of the relevant characteristics of the ecosystem in question, and the identification of property rights arrangements, institutions and knowledge systems that have adapted to and cope with their resource base in a sustainable fashion. It is concluded that resilient social/ecological systems have responded to and managed ecological feedback instead of trying to avoid them. Such an adaptive behavior should be a major component of western resource management.

## **Ecological economic and property rights issues in Bangladesh's openwater and floodplain fisheries**

**Doris Capistrano, M. Ahmed, M. Hossain**  
*The Ford Foundation*  
Bangladesh

In Bangladesh, government policies, technological change and externally - funded mega-projects combine with extreme poverty, inequality and population pressures in ways that threaten the sustainability of one of the world's most diverse and naturally productive fisheries and the well-being of over 100 million people. The paper examines how increasingly enterprise-oriented fisheries policies,

technology, and other factors effect the access to and distribution of benefits from Bangladesh's openwater and floodplains. It reviews lessons from the country's experience with fisheries resource management schemes, some involving non-governmental organizations. Finally, it identifies major issues and explores other possible approaches to managing openwaters and floodplains.

## **Global warming, policy negotiation, and the issues of allocation, distribution, and scale**

**Mark A. Ridgley**  
*University of Hawaii*  
United States

A complete policy on anthropogenic climate change would require addressing at least four major sets of questions: 1. GHG Levels --what level of atmospheric greenhouse gases (GHG) should we tolerate?; 2. Burden-Sharing --what share of the desired global GHG reduction should each nation or region be responsible for? 3. Actions --what are the best actions to take to effect such reductions and who should take them?; and 4. Institutions --in what institutional context should these actions occur?

This paper develops an approach to articulating these policy questions by showing how these

questions relate to the general policy goals of effectiveness, efficiency, and equity, and to Daly's distinctions among allocation, distribution, and scale determination and the proper policy instruments to use in effectuating these tasks. The approach focusses on equity, argues for a pluralistic view of the concept, and demonstrates how to measure it. The paper then presents a procedure based on multicriterion decision making which can accommodate these different measures of equity and can be used to support international negotiation. An example illustrates the procedure.

## **Will new property right regimes in Central and Eastern Europe serve nature conservation purposes?**

**Tomasz Zylicz**  
*Warsaw Ecological Economics Center*  
Poland

The pre-1989 political regimes in Central and Eastern Europe were notorious for their poor environmental performance and thus worked against conservation measures, at least indirectly. There is an impressive network of well-managed national parks there. Many of them, nonetheless, have suffered from excessive pollution originating from inefficient local economies. The collapse of the old political and economic systems has already proved environmentally beneficial because some of the worst polluters went bankrupt and pollution inspectors started to exercise control over the growing private sector in a way they could not with respect to the state-owned industrial dinosaurs. All this works towards curbing indirect (industrial pollution) pressures on national parks and other ecologically valuable areas. At the same time, however, these are under increasing direct pressure from individuals wishing to exercise their property rights. This manifests in three ways. First, parts of national parks are being claimed by previous land owners who feel they were not reimbursed fairly. Second, there are private or communal enclaves left within parks' boundaries which created a lot of ambiguity about their status. Third, even where the state ownership of a park's land and its integrity are not challenged, the neighboring land owners protest against development constraints implied by the park's existence.

In this paper an example of the conflict between conservationists and Piecki, a rural municipality in Northeastern Poland, is analyzed in order to illustrate how changing property right regimes have influenced the social context of nature protection. The municipality resists establishing the Mazurian National Park, whose presence would imply certain economic restrictions. The pattern emerging from this case study is a complex one. On the one hand, any development constraints are perceived as more severe than before when there was little private entrepreneurship around. On the other hand, however, the enforceability of the law has improved as a result of the increased transparency of public decision making. This includes the enforceability of environmental regulations. Thus the fate of nature protection crucially depends on the ability of conservationists to demonstrate economic benefits from investing in natural capital rather than letting it be degraded. A project is under way to identify local sustainable development options and to show that land-use restrictions, when combined with a larger package of social and economic improvements, can gain the support of the local population for the national park idea.

## Creating the Institutional Setting for Sustainability

### Human Settlement and Sustainability

#### Panelists

1. John Holmberg: *Socio-ecological principles for a sustainable society*
2. Marilia Pastuk and Peter May: *Valuing social sustainability: conceptual issues applied to Favela Hillsides in Rio de Janeiro*
3. Elizabeth Dunn and Amelia Oliver: *Sustainable income strategies in the Maya Biosphere*
4. Rosendo Pujol: *Human settlements and sustainability in Costa Rica*
5. Benjamín Ortiz-Espejel and Víctor Toledo: *Economic-ecological analysis of natural resource management by indigenous communities in the Mexican tropics: the Totonaca case*

Chair: Carlos Quesada, *Universidad de Costa Rica, Costa Rica*

#### Socio-ecological principles for a sustainable society

John Holmberg, et.al.  
*Goteborg University*  
Sweden

A long-term sustainable global society must have stable physical relations with the ecosphere. This implies sustainable material exchange between the society and the ecosphere. Physically, sustainable development then means i) development towards such a sustainable exchange and, after this has been reached, ii) development within the boundaries of sustainable exchange.

We apply a system perspective and put our focus early in the causal chain. From the condition of stationarity, we derive four principles for a sustainable society. The first principle deals with the exchange of substances with the lithosphere, the second principle concerns substances produced within society, the third principle deals with the manipulation of the ecosphere and the fourth principle with the societal metabolism and production of services in the human sphere.

The socio-ecological principles thus deal with the physical limits for society (Daly's Plimsoll line) and the physical efficiency of society within those limits. But these concepts are meaningful only if related to purpose and value. The values that must be honored in a sustainable society are *human value* and the *value of life on Earth*. The first implies that human dignity and justice are societal goals. The second implies that life and life-supporting systems are valued in their own right and not only for their support of the human society.

These four socio-ecological principles have been worked out in close contact with a wide pedagogical practice. They have been found to function well in teaching situations and many actors within business and local administration have adopted them as the basis for their strategies towards sustainable development.

## **Valuing social sustainability: conceptual issues applied to Favela Hillsides in Rio de Janeiro**

Marilia Pastuk and Peter May  
*Federal Rural University of Rio de Janeiro*  
Brazil

Environmental valuation as developed in the majority of cases documented in the ecological economics literature appears not to have given much attention to aspects of the socio-economic reality of developing nations. This makes it imperative to seek, at the macro level, an adaptation of sustainability concepts with an eye to their relevance for specific conditions of economically marginalized majority groups.

We observe 1) that socio-environmental valuation concepts based on market equivalents are inadequate for individuals not fully engaged in the formal economy. Furthermore, 2) neither welfare economics nor biophysical valuation are particularly adequate to reflect distributive goals. Finally, 3)

there is an unfortunate absence in the literature of means to integrate socio-political conditioning factors when valuing environmental costs or benefits.

This paper seeks possible paths to resolve these difficulties, through *ex post* evaluation of environmental recuperation measures undertaken in critical zones of *favela* hillsides in Rio de Janeiro. These measures were carried out by local communities in cooperation with the city government. The study identifies principal beneficiaries of these investments, and suggests means to select priority actions that, involving more effective participation of community residents, could assure more effective implementation.

## **Sustainable income strategies in The Maya Biosphere**

Elizabeth G. Dunn and Amelia B. Oliver  
*University of Missouri*  
United States

The Maya Forest of Mexico, Belize, and Guatemala is the second largest humid tropical forest in the Americas. The Guatemalan portion, relatively untouched until the 1980s, has come under increasing economic and demographic pressures; recent estimates place the annual population growth rate near 7 percent. Responding to these pressures, the Government of Guatemala established the Maya Biosphere Reserve (MBR) in 1990. The MBR encompasses 1.5 million hectares, with .5 million additional hectares designated as buffer zone.

The National Parks Council (CONAP), charged with protecting the area and regulating economic activity, has few resources and little enforcement

capability. As a consequence, forest degradation and loss of biodiversity continue to accelerate. This research analyzes the potential for institutional restructuring which could create effective economic incentives at the individual and community levels for sustainable development of the MBR.

The population of the MBR is composed of low-income households who rely on a diverse set of activities to generate income. These activities range from production agriculture (*milpa*) to non-timber forest products (*chicle, xate, allspice*). Both the diversity and sustainability of income strategies tend to increase with length of residence, while

newcomers to the MBR tend to rely more on activities associated with deforestation.

This study utilizes data from a formal survey of 45 randomly selected households in the center of the MBR. These data document family geographic origin (until now a matter of conjecture), length of residence in the MBR, income levels, and sources of income. Analysis of this data provides the basis for

the design of sustainable income strategies for residents of the MBR. The preferred income strategies achieve the dual objectives of providing families with acceptable standards of living while protecting the region's valuable natural resources. The recommended income strategies provide built-in incentives for protection of the MBR at the community and local levels.

## Human settlements and sustainability in Costa Rica

Rosendo Pujol  
*Universidad de Costa Rica*  
Costa Rica

Human settlements in Costa Rica are concentrated in relatively few areas. This is not necessarily negative, because it allows the rest of the territory to support other activities. The concentration of population in cities requires the construction of an infrastructure which mitigates the impact of human activity on natural systems.

Important ethical changes are needed to improve the sustainability of the development process. At the same time, prices or "economic signals" are needed that adequately reflect the environmental costs of production, distribution, and consumption of goods and services (like water, electricity, and

transportation). In some cases, market mechanisms must be corrected through proper regulations because they are unable to adequately reflect these environmental costs. At the same time, it is necessary to correct public policies that seriously reduce the sustainability of urban activities.

The Greater Metropolitan Area of San Jose has important problems of sustainability that must be faced in the next years. Among them are: protection of the remaining green belt; proper management of solid waste; improved efficiency in the use of water, electricity and liquid fuels; rehabilitation of urban rivers, and; traffic accident reduction.

## Economic-ecological analysis of natural resource management by indigenous communities in the Mexican tropics: the Totonaca case

Benjamín Ortiz-Espejel y Víctor M. Toledo  
*Centro de Ecología, Universidad Nacional Autónoma de México*  
México

This paper describes and analyses the strategy of natural resources management in a Totonaca community along the Veracruz coast, from the perspective of the economic balance of its main productive practices.

This work has methodological value in its presentation of economic efficiency indicators for various productive practices, represented by family effort invested in time units (one year) and space units (1 hectare).



The study revealed the existence of an equitable distribution of land resources among all (166) community members. A dominant pattern of multiple management of resources among the farmers of this community was also identified. This management pattern results in a productive food surplus (based on corn plantation products and the family garden, complemented by the purchase of

other products) and energy self-sufficiency (based on firewood) in the community.

Even though this case could be seen as a rare exception, from the point of view of management alternatives, it represents a real example of profitability, self-sufficiency, and resource conservation.

## Creating the Institutional Setting for Sustainability

### Energy, Entropy and Time: ecodynamic approaches

#### Panelists

1. Mayumi Kozo: *Effectiveness and limitation of energy analysis for natural resources and environmental management*
2. A. Donati, G. Sabatini, A. Giolitti and C. Rossi: *Metabolic investigation of selected ethanol-producing bacteria in the framework of energy input/output in agriculture*
3. S. Bastianoni, S. Jez, N. Marchettini, E. Tiezzi and S. Ulgiati: *A bio-physical multicriteria approach for analysing biomass to energy conversion processes*
4. Mario Giampietro: *A biophysical assessment of the welfare function and labor productivity: implications for sustainable development*

Chair: Enzo Tiezzi, *University of Siena, Italy*

#### Effectiveness and limitation of energy analysis for the natural resources and environmental management

Mayumi Kozo  
*The University of Tokushima*  
Japan

Thus far many analytical as well as synthetic models of energy analysis have been proposed to tackle natural resources and environmental problems: net energy analysis, gross energy analysis, emergy analysis, etc. The main purpose of this paper is to examine the rationale of underlying assumptions (sometimes tacit assumptions) made in these models, then to clarify to what extent these models can be properly applied to the resources and environmental issues and to present some insuperable limitations inherent in these models. Four issues are particularly featured: 1) Is it possible to treat rightly labor and waste matters in the framework of these models? 2) What is the capital cost involved in the process of

energy transformation? Is it reasonable to make a calculation of capital cost only in terms of energy? 3) Is it justified to evaluate two different types of technology based solely on energetic terms? 4) Can these models be applied directly to the assessment of environmental damages and economic issues?

Then an alternative model is proposed in which not only heterogeneous but also the intrinsic property and role of each resource and environmental capital are taken into consideration. Finally this model is applied to technological assessment of the direct use of solar energy.

## **Metabolic investigation of selected ethanol-producing bacteria in the framework of energy input/output in agriculture**

A. Donati, G. Sabatini, A. Giolitti and C. Rossi  
*University of Siena*  
Italy

The role of biotechnologies in the transformation of agricultural products into fuels, chemicals and feed stocks has generated extensive interest. The "Agro-industry Biotechnological Research Centre (ISBA)" in the Province of Siena (Italy) was constituted to promote the harmonious and integrated development of agro-industry with advanced technological support.

Several innovative projects were considered, among which the production of natural dyes, essential oils, drugs, etc., and their impact in terms of energy input and economic evaluation were evaluated. In particular, the contribution of agriculture wastes (obtained from typical and innovative cultures) as a source of fermentable material to produce energy was investigated. Different alternative biomass degradation pathways were considered together with the energy analysis of the processes.

Our results point out that ethanol is probably the most interesting end product of biomass

conversion. In particular cellulose and hemicellulose hydrolysis products are excellent substrate for growing microorganisms and producing ethanol. The use of selectively carbon-13 enriched substrates makes it possible to study the "In vivo" metabolization processes of microorganisms by  $^{13}\text{C}$  NMR. This technique was applied to the fermentation of [2- $^{13}\text{C}$ ] xylose and [1- $^{13}\text{C}$ ] glucose by a newly isolated *Klebsiella planticola* (G11) strain.

Since [1- $^{13}\text{C}$ ] and [2- $^{13}\text{C}$ ] sugar carbons have a different metabolic fate, isotopic enrichments enabled us to separate the xylose from the glucose signals in the carbon NMR spectrum and calculate the contribution of each sugar to end-production yield.

Metabolic processes involve the transformation of energy through different metabolic pathways. these processes can be well described by energy system models. These models describe the flows of energy among systems components, which interact to produce other kinds of energy, usually of higher quality.

## **A bio-physical multicriteria approach for analysing biomass to energy conversion processes**

S. Bastianoni, S. Jez, N. Marchettini, E. Tiezzi and S. Ulgiati  
*University of Siena*  
Italy

A project for a Center of Biotechnological Research in Agro-Industry is being developed in Southern Tuscany. Its fundamental purpose is to promote an harmonious and integrated development of the agro-industry field through advanced technological support. As a part of this project, a detailed feasibility study for biodiesel production from

oil seed crops has been performed, on the basis of crop yields in the surrounding area and current process efficiency of available advanced technologies.

Crop production and their transformation processes have been analyzed, accounting for

energy, land and carbon balance. In addition, an emergy (spelled with an m) analysis has been performed, in order to take into account, on the same basis, inputs coming from renewable and nonrenewable energy sources as well as from minerals, goods and labor involved in the process. Topsoil used up has also been considered.

When analyzing a proposal for the technological

improvement of a source exploitation, its feasibility, usefulness and sustainability within biosphere equilibria should be assessed in the short as well as in the long run. Therefore, indices based on energy, emergy, carbon and land balances have been calculated and compared, as part of a Bio-Physical Multicriteria Approach (BPMA) proposed for the analysis of energy conversion processes.

### A biophysical assessment of the welfare function and labor productivity: implications for sustainable development

Mario Giampietro  
Cornell University  
United States

In order to be sustainable an economic system must be compatible with both the expectations of humans comprising it and the natural ecosystems embedding it. Subsistence societies at low population density are ecologically compatible but have proven not to be economically sustainable when interacting with more advanced economies. Developed societies based on the market mechanism are winners on the economic side, but not sustainable in the long term on the ecological side. This paper explores the biophysical roots of this dilemma in theoretical terms (part I) and discusses its implications for the technical development of agriculture as an example (part II).

**PART I - Two different types of pressure affect the evolution of a society:** i) an internal pressure, determined by the aspirations of humans composing society (what is defined as an acceptable standard of living?); ii) an external pressure, determined by the ecological constraints faced by society. A model of energy analysis is used to define and measure these two types of pressure. The internal pressure is measured by the Welfare Function of society:  $WF = (MF \times \text{average body size}) \times (\text{Exo/Endo}) / (F_{w+kg} \times F_{w-time})$ . The welfare function is proportional to the flow of resources consumed per capita. For example, in the U.S.A., the flow of energy consumption - the numerator- is calculated using the following values: MF (metabolic flow) = 1.9 W/kg; average body size

= 57.7kg; Exo/endo (ratio between commercial and metabolic energy) = 90/1. The denominator is the fraction of working time of the total population and equals about 11% for the USA [ $F_{w+kg}$  (fraction of working population expressed in kg) = 0.60;  $F_{w-time}$  (fraction of working time of the working population) = 0.18]. A low fraction of working time indicates a high number of retired elderly (long life span) and students (high education level) and a lot of vacation and leisure time for workers. Increasing the welfare function requires an increase in labor productivity; since the increasing flow of goods and services consumed by society must be generated by a decreasing fraction of human time allocated to work.

The link between labor productivity and welfare function can be shown in terms of both energy and money. For example, in 1990 the per capita income in the USA was \$21,700 (\$2.5/hr) whereas in Burundi it was only \$210 (\$0.02 US/hr). These figures can be corrected for the WF [1 hour of work delivered in the USA implies 9 hours spent in non-working activities, whereas in Burundi this ratio is 1 to 4], to obtain that in 1990 the average economic productivity of labor (GNP/hours of labor) in the USA was \$22.3/hr (the flow of \$2.5/hr per capita was generated only during 11% of the total time of the population). In the same way the average economic productivity of working time in Burundi was \$0.80/hr. The same calculation can be applied to the

average energy return of labor in the USA. A per capita consumption of 230,000 kcal/day implies that each hour of labor in the USA has to generate a throughput of 90,000 kcal of commercial energy! (9,600 kcal/her per capita divided by 0.11).

The level of labor productivity (both in economic and energetic term) is determined by the mixture of economic activities performed in society. It is here that the external pressure enters into play. The ability of an economic system to boost the labor productivity depends on two factors: i) the quantity of natural resources available (natural capital); ii) the ability of the system to use these natural resources (technological capital). The interaction of these two factors is what defines the external pressure operating on an economy, and is assessed in the model by the flow of energy (or resource) throughput maintained on average per hour of labor in society (POL).

PART II - Technological development of agriculture in developed and developing countries can be used to illustrate the application of the model. The welfare function (a need for a high labor productivity, to boost farmer's income) and ecological pressure (a need for high productivity per hectare due to demographic pressure) both affect in a negative way the sustainability of agricultural techniques. To achieve a higher throughput per hour and per hectare, modern agriculture is forced to decrease the output/input energy ratio and to increase the stress on the environment. The particular combination of internal and external pressure experienced by a country defines the room for substituting technological capital for natural capital. Developed countries, such as the USA, that enjoy a fair amount of arable land per farmer and a surplus of commercial energy generated by other sectors of the economy, are still in the position to make rational choices for the future development of agriculture (e.g. set aside, low input agriculture, social security for farmers in case of crop failure). In the EC, the shortage of land per farmer (e.g. 9 ha in EC versus 64 ha per farmer in the USA) already made the substitution of technological for natural capital impossible. EC farmers use twice as much technological inputs as US farmers per hectare (10.9 vs 5.4 million kcal/ha) but have a labor productivity that is less than 1/5th (18,400 vs 95,600 kg/worker/year for grains) that of US farmers. This

means that if the same welfare function is to be kept, the EC has either to protect its farmers against international competition by guaranteeing higher prices (tariffs and subsidies) or reduce their number to a point that the arable land per farmer will be similar to that available to US farmers.

Note that this solution implies that as soon as the welfare function is increased in a country, the number of workers in economic sectors exploiting natural resources must be decreased if that country is freely trading with countries where the welfare function is lower. For instance, the same quantity of rice exchanged for dollars on the international market is equivalent to the average return of less than half an hour of labor in the US and about 125 hours of labor in Burundi. To be competitive in a free, global market either the farmers in the US must have a labor productivity (crop produced per hour) 250 times higher than that of farmers in Burundi or they will be sooner or later displaced. Again the ability to keep up such a high labor productivity depends on: i) availability of natural capital per worker (that is continuously shrinking because of demographic growth); ii) technological capital; and iii) the gradient in the welfare function existing among trading countries.

The situation of many developing countries, such as China, India or Central American countries, is frightening. When demographic pressure is high and technological capital low, economies struggle for a better income (higher labor productivity) with increasingly lower levels of natural capital per capita. Arable land per agricultural worker in these countries is often a small fraction of that available in the US and the only way to be competitive is by keeping the welfare function low. This biophysical analysis of labor productivity shows that there is no chance of success for "the historic pattern" of economic development (i.e. intensification of agriculture as a driving force for development of the industrial sector). That pattern worked in the past, but things have changed and it is unlikely to work today; the welfare function and population are growing too fast all over the world and developing countries are on the losing side in the terms of trade, military power, and control of macroeconomic parameters.

## **Creating the Institutional Setting for Sustainability**

### **Valuation and Ecological Economics**

#### **Panelists**

1. Peter Soderbaum: *Reformulating the valuation issue: positional analysis as an example of an alternative approach*
2. Richard Carson: *Valuation of tropical rainforests: philosophical and practical issues in the use of contingent valuation*
3. Karl-Goran Maler: *The production function approach to valuation*
4. S.J. Doherty, F.N. Scatena, H.T. Odum: *Ecologic-economic value analysis of multiple uses in the Luquillo Experimental Forest, Puerto Rico*

**Chair:** Michael Common, *Australian National University, Australia*

#### **Reformulating the valuation issue: positional analysis as an example of an alternative approach**

Peter Soderbaum  
*Swedish Institute of Agricultural Sciences  
Sweden*

The issue is related to the purposes of valuation, and particularly to cost benefit analysis, for making social decisions about environmental use. It is argued that cost benefit analysis is inappropriate. There are no uniquely correct valuations for use in that framework. Positional analysis is described as a

framework for illuminating decisions and suggests that positional analysis stands in the same relation to institutional economics as cost benefit analysis does to neoclassical economics. The paper concludes with implications arising for ecological economics.

#### **Valuation of tropical rainforests: philosophical and practical issues in the use of contingent valuation**

Richard T. Carson  
*Department of Economics, University of California  
United States*

Contingent valuation has become the most commonly used approach to valuing non-marketed

environmental resources. In developed countries, it has been extensively used to value environmental

amenities such as air and water quality, outdoor recreation, and the preservation of environmentally sensitive areas. In developing countries, its principal use has been in the valuation of basic environmental services such as water delivery and waste removal. In contrast, contingent valuation has seen little use in determining the economic benefits of global environmental problems even though it is becoming increasingly apparent that many of the principal benefits of policies to deal with such problems are

not easily priced in the marketplace. In part this may be because the philosophical issues surrounding the use of contingent valuation to value global environmental issues go well beyond most of its current uses and because the practical issues of implementing a contingent valuation survey across multiple countries are imposing. Both of these issues are explored at some length in this paper using valuation of the preservation of a set of tropical rainforests as the example.

### Ecologic-economic value analysis of multiple-uses in the Luqillo experimental forest, Puerto Rico

S. J. Doherty, F. N. Scatena, H. T. Odum  
*University of Florida*  
United States

The Luqillo Experimental Forest (LEF) in Puerto Rico is an 11,000 ha forest managed for production, recreation, education and research. In addition to these direct multiple-uses, the forest supports by-product services not recognized in monetary accounts, including carbon sequestration, water supply and habitat for biodiversity. We completed an energy systems analysis of Puerto Rico and LEF to value contributions from the forest, its ecosystem processes and stored natural capital relative to other activities on the island. A relationship was made between total, island-wide resource-use, including environmental production, and the gross economic product of Puerto Rico. With this index the contribution of any sector, including the forest, could be valued relative to the economic activity generated by Puerto Rico's combined ecologic-economic system.

A ratio of invested, economically derived resources to environmental production of less than 1 indicates that LEF contributes more to the economy of Puerto Rico than is invested. This is especially beneficial to an island largely dependent on external trade and where the regional investment ratio for production sectors is more than 40 to 1. Further, in

addition to direct services from forest processes, LEF is shown to attract almost 3 times the resources to the island, through tourism and research activities, than is invested from the economy.

Each of 4 lifezones present in LEF were separately evaluated for net production and water supply. Lowland subtropical wet forests, with the greatest production and above ground biomass storage had the greatest annual contributions (\$940/ha/yr production and \$57,200/ha stored in biomass). The lower montane elfin rainforest had the greatest annual per hectare contribution from water runoff (\$3760/ha/yr), with 96% of its precipitation runoff (18hm<sup>3</sup>/yr) to lower elevation systems. These values help us recognize the role of energy transformations and convergence from higher altitude forests.

For the entire forest, by-product services supporting multiple-users were valued at more than \$3000/ha/yr; an annual contribution of 34 million dollars -- 7 times the annual operating budget of LEF. Our analysis also indicates that the value of stored forest biomass, representing past environmental work, is on average 14 times greater than current land prices.

## Creating the Institutional Setting for Sustainability

### Business at Corporate Level and Ecological Economics

#### Panelists

1. Miguel Sobrado: *Managerial ecology and social change*
2. Gerald Nehman: *Economic modeling for environmentally conscious manufacturing*
3. John P. Ulhoi: *Sustainable industrial production: practical applications of ecological economics at the corporate level*
4. Raimund Schwendner: *Sustainable innovation and quality management*
5. Richard Bell: *Innovative solutions to down to earth problems*

Chair: Lorena San Román, *Universidad Nacional, Costa Rica*

#### Managerial ecology and social change

Miguel Sobrado  
*Universidad Nacional*  
Costa Rica

In every stable economic system there are employers that, competing and complementing each other in several economic sectors, adopt various roles, functions, and ways of organization and management that promote, adjust, and transform economic and social development. These employers are defined by their capacity to create technological and social links and to promote, or inhibit, greater social welfare. The network of relations between these employers works as a system that maintains equilibrium among its components and stimulates the economy and development in general. Its interactions create regular patterns and can result in certain conflicts. These conflicts either change the system through successive adjustments or break the pattern, thus creating larger changes and new levels of equilibrium.

Equilibrium facilitates innovation and the activities of enterprises, as well as the transfer of goods and services. The environment produces equilibrium between various types of employers and favours

technological progress, innovation, and change together with systemic adjustment. Or, on the contrary, it can affect and delay progress.

In every economic system there are several types of employers: creators, organizers, brokers, carrion eaters, and open predators. The State plays an important role by keeping a healthy equilibrium amongst the several types and by maintaining the action and initiative of the creators. This equilibrium, however, is very fragile.

When, because of ideological reasons, State policies are oriented towards closing private or public enterprises, the system's equilibrium is broken. The system moves into chaos, as does the social, political, and environmental systems surrounding it.

The "managerial ecology" concept applied to the Russian experience confirms that the structural-shock policies have caused a boom of predator employers. State policies benefiting these employers have



prevented the reform and renovation of the economic system. Predators (mafia) want to make easy money. They don't create wealth but disband enterprises whose assets can be easily sold. As predators' power and wealth grow, their influence on the political class is consolidated, and this further

contributes to delay the application of effective reforms. In the meantime, the economic, social, and environmental ecology of the country is being destroyed.

## **Economic modeling for environmentally conscious manufacturing**

Gerald Nehmanm

*University of Texas at Arlington*

United States

The Pollution Prevention Act of 1990 redefined environmental protection to focus on ways to reduce the generation of waste. Source reduction and waste minimization are terms that are now in the environmental lexicon. Unfortunately, manufacturing enterprises still downplay environmental issues by ignoring environmental costs at the design stage. They continue to ignore the short term costs of environmental control and the long term environmental costs which are, in large part, still

considered to be externalities, that is, costs that are external to the enterprise. This paper will show how firms can incorporate environmental costs and benefits into their decision models explicitly, just as resource and labor costs are now included. A case study incorporating an innovative environmentally conscious technology for circuit board manufacturing called liquefied metal jet will be used to empirically validate the modeling approaches.

## **Sustainable industrial production: practical applications of ecological economics at the corporate level**

John P. Ulhoi

*Department of Organization and Management*

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The natural environment needs to be recognized as a key strategic problem that can acquire "life-or-death" importance to the firm. Almost daily, the deterioration of the biophysical environment is featured in the press. In the 1960s and 1970s, which were characterized by opposing camps of enthusiastic proponents of growth and zero-growth fanaticism, it was flatly asserted that consideration of nature was incompatible with considerations of economic growth. This post-war economy-ecology controversy developed in two waves.

The first wave set in during the 1960s and reached its top in 1972 when the "Rome Club" published its "Limits to Growth". Concern was directed towards both industrial pollution and resource depletion. The economist gravely intoned that if we continued to want prosperity, then we would have to accept an (unavoidable) imbalance between ecology and economics. Against this, the ecologist zealously argued that economic growth should take second place to the interest of nature. This led, amongst other things, to the appearance of

zero-growth schools, which in varying degrees attempted to revive some of the basic ideas of Thomas Malthus and John Stuart Mill. "End-of-pipe" legislative regimes were introduced and step-by-step implemented in the United States and in European and Scandinavian Countries.

The second wave emerged in the early 1980s and was characterized by the introduction of a new global "stewardship" (argued by Dr. Mustafa Tolba from the United Nations) and peaked in 1987, when the "Brundtland Commission" published its report "Our Common Future". Global environmental problems such as the green house effect and the holes in the ozone layer were on the top of the international environmental agenda.

An environmentally sustainable future can be achieved only by making changes in the way decisions are reached at all levels of society. It therefore will become axiomatic that corporations integrate environmental considerations into their economic decision-making. This situation requires the development of a new paradigm of management and engineering which overcomes the deficiencies of the linear, mechanistic model. A corporate understanding and recognition of the intimate relationship between the man-made (the economic) and the natural (the ecological) systems is a critical bottleneck during the process of changing towards a societal sustainable development trajectory.

The purpose of this panel is to explore the theoretical and practical corporate issues confronted when a firm seeks to re-conceive its management and production systems within the context of ecological - and economic sustainable principles. The

specific issues to be addressed by the panel will be:

- The nature of the process of transforming non-sustainable business practices into more sustainable practices.
- The implications (theoretical as well as practical) of implementing corporate strategic environmental and resource management on ecological and economic premises.
- Implications for product development and management.
- Total Product LCAs from a "cradle-to-grave" perspective.
- The role of environmental impact assessment and forecasts.
- The definition and role of green products and environmental marketing.
- Potentialities and limitations of corporate implementation of ecological-economical principles and methods.

The panel will seek to approach these themes in an integrated fashion recognising the interdisciplinary and complex nature of the topic. Since this session is based on a on-going 5-year joint research programme by the panel participants, and as such is far from being fully developed, active participation from the audience is encourage in discussing the ideas and suggestions proposed by the panel. At the beginning of the session each panel participant will make a short presentation (10 min.) capturing his views on where we are, and where we are going within this new and emerging field. In the remainder of the session the panellists will participate in a wide-ranging discussion simulated by critical question from the floor.

## **Sustainable innovation and quality management**

Raimund Schwendner  
*University of Munich*  
Germany

There are effective methods of innovation and quality management which can contribute to successful sustainable development. To discuss

these instruments and their applicability to ecological-economic demands should be the main topics of this work.

They refer to processes of strategic management, regarding aspects of personnel management and management qualification. Such instruments as reflecting teams, selfcoaching team organization, innovative management culture and environmental quality management should promote sustainable problem solving. Case studies are used to demonstrate underlying ecological demands on economic growth and their various impacts on management skills. Also the influence of economic philosophies on organizational behavior and human resource management should be considered. The following items will be discussed:

1. To cope with future - challenges for organizational development
  - Innovation and risk evaluation

- Strategies to cope with complex systems
2. Differences between traditional and modern organizational demands
    - The shift of priorities: from "profit" to sustainability
    - Consequences for organizational system building
  3. Human resource management in complex organizations
    - Ecological multiprocess and multiproject management
    - Information systems: creating systemic competence
    - Integration of "Environmental Quality Management".

### Innovative solutions to down to earth problems

Richard Bell  
*Evergreen Global Resources, Inc.*  
United States

As time marches toward the twenty-first century, we find ourselves in a world beset with problems of dwindling supplies of untapped resources and increasing quantities of wastes. The old philosophies of viewing natural resources as endless, and wastes as something to be hidden away and forgotten, are no longer working. Those philosophies have led to the creation of a one-way track, from resource to product to trash.

Current recycling efforts signal the beginning of a new approach, but most recycling approaches to date are actually little more than attempts to make adjustments in the business-as-usual, one-way track, and have not signaled a change in basic philosophy. In general, each recyclable commodity is being dealt with independently, and the goal seems to be to reintegrate the recovered materials back into the same system with as little change as possible.

Throughout most of history, mankind has handled its solid wastes, particularly municipal wastes or garbage, by burying it or dumping it into

bodies of water, but in the face of relatively recent recognition that improper handling of solid wastes can create short term and long term pollution problems, solid waste management has become a matter of increasing concern. Recovery of useable resources from solid wastes is another factor which has led to increasing concern for proper management and utilization of solid wastes. Of the different types of solid wastes, municipal solid waste is the most significant in terms of sheer volume and variety of composition.

Numerous approaches have been suggested and utilized for the handling of solid wastes, though disposal in landfills has been and continues to be the most widely used approach by far. Although disposal in properly constructed, operated and maintained landfills appears to be a relatively safe method of waste management over a short span of time, major concerns remain about the long term safety of even the best designed and operated landfills are constructed with a generally impervious liner to serve as a barrier against leaching of wastes into water

supplies, but any breach in the liner results in failure of the entire containment system. Further, conventional design and operation of landfills for disposal of solid wastes fails to effectively address the potential for reuse of waste stream components as resources.

Incineration is another approach which has been in long term use for disposal of solid wastes, sometimes alone and sometimes with recovery of energy from the heat of combustion. Again, while offering partial solutions and recovering at least some portion of the resource value of the incinerated wastes, incineration can produce air pollution, and

the use of all waste components for heat is often an extremely inefficient approach to recovery of the resource value of many waste components.

Composting of municipal wastes is another approach which has been attempted, but which has failed to provide a comprehensive solution to the waste management problem. Although some components of municipal waste can be effectively composted, many components are not amenable to biological degradation or may retain toxic or hazardous characteristics through the composting process.

## Creating the Institutional Setting for Sustainable Development

### Contributions of evolutionary, organizational and institutional economics to ecological economics

#### Panelists

1. Paul Christensen: *The interdependence and connectivity of the world: a physiological and evolutionary approach to economics*
2. Silvio Funtowicz and Jerry Ravetz: *Emergent complexity and ecological economics*
3. Martin O'Connor: *Externality as a constructive principle in institutional evolutionary ecological economics*
4. Silvie Faucheux and Geraldine Froger: *Decision-making in ecological economics*
5. Mohammed Dore: *The horizon and the equitable distribution of non-renewable resources*

**Chair:** Paul Christensen, *Hofstra University*, United States

### The interdependence and connectivity of the world: a physiological and evolutionary approach to economics

Paul Christensen  
*Hofstra University*  
United States

Many economists argue that standard market theory, when corrected for externalities or extended to include environmental accounting, provides a satisfactory framework for analyzing economic processes. The difficulty with this view is that standard (neoclassical) theory is constructed on behavioral and physical assumptions which are fundamentally inconsistent with the deep interdependence and connectivity of energy, chemical, physiological, ecological and social processes. The development of ecological economics cannot avoid issues involving the reconstruction and redirection of economic theory. An ecological point of view entails a modern metaphysics, epistemology and ontology.

Insights from many disciplines will be required for this reconstruction (including the various schools of economics). In particular, it is necessary to effect

a synthesis of ecological, organizational and evolutionary points of view. An important bridge to this synthesis is the development of the "physiological" component of economic systems. Ecology, physiology, psychology, and evolution are interdependent (and inseparable) levels of analysis in biology. Modern economics, it is argued, lacks a physiological structure linked to environmental structures and processes and to evolutionary change and transformation.

This paper will develop central elements of a physiological approach to economics based on the development of the energy, technological and organizational approaches to economic phenomena implicit in classical political economy. In order to show the implementation of this approach, it will examine three fundamental concepts of neoclassical economics reviewed (and largely accepted) by Daly

and Cobb in their important and pioneering work, *For the Common Good* (1989). These are the theories of diminishing marginal utility and the related issue of satiability, the theory of diminishing returns to land,

and the theory of the structure which Daly and Cobb and other ecological economists combine with neoclassical market theory is highly problematical from a bio-physical and organizational point of view.

## Emergent complexity and ecological economics

Silvio Funtowicz and Jerry Ravetz

*Institute for Systems Engineering and Informatics*  
Italy

In response to the new leading problems for science, in which the traditional reductionist approach is patently inadequate, complex systems are becoming the focus of important innovative research and application in many areas. This development reflects the progressive displacement of classical physics as the exemplar science by evolutionary informatic systems.

A first distinction is between systems which are merely complicated and those which are complex, the former studied by classical physics, and the latter by biology. In order to study ecological-economic systems, it is necessary to further refine "complexity" into ordinary and emergent. In ordinary complexity, lacking intentionality and purposes, the most common pattern is a complementary of competition and co-operation, with a diversity of elements and subsystems. By contrast, emergent complexity frequently oscillates between hegemony and fragmentation (which is a conflict among plural

attempted hegemonies). We posit that diversity is desirable, for this is the key to sustainability. In ordinary complexity it occurs naturally; while in emergent complexity it requires a special awareness and commitment for its achievement and maintenance.

Mainstream economics can be seen as an attempt to reduce economic systems to mere complication, on the model of Hobbes. Recent attempts at reform through the introduction of complex systems remain at the level of ordinary complexity, operating at the lower dimensions of the total phase-space of the whole eco-system. This approach can provide powerful heuristic tools for exploring small-scale and local processes. However, to understand and manage the interaction of qualitatively different subsystems, including those possessing consciousness, purposes and ethical judgements, it is necessary to extend our understanding of emergent complexity.

## Externality as a constructive principle in institutional evolutionary ecological economics

Martin O'Connor  
*University of Auckland*  
New Zealand

The paper takes the old concept of "externality" -- designating some sort of non-market interdependency between economic agents -- and uses it as a constructive principle for insights into

organizational structures and change processes in economic-ecological systems. First, a critical exposition is given of the concept of externality, showing how a radical distinction must be made

between externality as a formal feature in a model of general economic equilibrium, and externality as a "spillover impact" taking place in real historical time. Then we discuss how different classes of externality -- considered under the generic headings of pecuniary, physical, psychological, and political -- may be considered as constitutive of economic activity as a process happening in time. Applied particularly to the domain of ecological economics, this perspective enables us

to understand positively the roles of institutions and conventions in resolving distributional disputes and contradictions in environmental and natural resource management. It is shown, finally, how biophysical perspectives on complex systems (co-) evolution may be dovetailed with political philosophy and ethical precepts of reciprocity, in the social pursuit of norms of "sustainability".

### Decision-making in ecological economics

Sylvie Faucheux and Géraldine Froger  
*University Paris I Panthéon-Sorbonne*  
France

In any ecological economics framework, there is support for the implementation of a "precautionary principle". Such a principle implies the current safeguard of environmental resources against the potentially catastrophic outcomes of some decisions. These decisions, in which the precautionary principle is currently being involved, are those for which the probability distribution of future outcomes cannot be known with confidence. Given that most of the environmental effects of economic activities are unknown and unknowable in advance, it would appear that a theory of decision-making under environmental uncertainty might be useful.

The paper's main concern is with decision-making models under uncertainty for environmental issues and with the hypotheses of rationality underlying such decision-making models. The thesis supported here is that the most environmental problems such as the increase of the greenhouse effect, the reduction of the ozone layer or the loss of

biodiversity, are situated in a context of uncertainty, of irreversibility and complexity.

We shall explain why stressing the role of uncertainty, irreversibility and complexity implies a reversal of traditional attitudes towards decision-making. This presupposes a paradigm of economic rationality much broader than that of orthodox economics, called procedural rationality. Our paper is in two parts. The first part concerns the limits of the Bayesian decision-making approach. Based upon a substantive rationality hypothesis, such an approach cannot take into consideration environmental uncertainty and its implications, especially irreversibility. The second part concerns the decision-making analyses based upon the hypothesis of bounded and/or procedural rationality, as well as their ability to take account of the interactions between uncertainty, irreversibility and complexity.

## The horizon and the equitable distribution of non-renewable resources

Mohammed Dore

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Canada

This paper argues that economic analysis of environmental issues is not acceptable to ecologists and environmental scientist: first, the horizon of the economist is too short; second, a set of ecological stylized facts are ignored by the economist in the economic value calculus; third, the economic theory of exhaustible resources (Hotelling theory) does not yield an operational policy for currently urgent environmental problems, and; fourth, received environmental economics treats environmental problems as marginal market failures in a Walrasian general equilibrium, which call for ad-hoc adjustments for these failures.

In this paper the ecological stylized facts are taken into account and the horizon is dictated by these facts. Next it is argued that economic value metric derived from Walrasian general equilibrium and

the concomitant consumer willingness to pay is inappropriate for the kind of horizon which is based on the ecological stylized facts, and that the Hotelling theory of rents must be replaced by the Marshallian theory of quasi-rents. This conclusion is derived by solving a socially optimal control problem which is a variation of Gray's problem.

The Marshallian theory is still fundamentally neoclassical; it is based on the neoclassical concept of opportunity cost. We show that when natural resources are valued in terms of opportunity cost, given the appropriate horizon, then the willingness to pay metric grossly undervalues resources and encourages their profligate use, harmful to future generations. Some important policy conclusions flow from the analysis. A model is developed to suggested how finite energy resources might be distributed over time from a social point of view.



## Creating the Institutional Setting for Sustainable Development

### Clean Technologies

#### Panelists

1. **Caroline Gallez:** *The incentive systems and the command control approaches used by governments for pollution problems: synthesis of some general implications for firms*
2. **William Schramm and Stella Schramm:** *Environmental constraints on industry in developing countries*
3. **Francisco de Sousa Ramos:** *A dynamic model with multiple discharge permits system*
4. **Arne Remmen:** *Solutions, strategies and new incentives: Danish experiences with cleaner technologies in the food processing industry*
5. **Haynes C. Goddard:** *The benefits and costs of alternative solid waste management policies*

**Chair:** Bjorn Johnson, Aalborg University, Denmark

#### The incentive systems and the command and control approaches used by governments for pollution problems: synthesis of some general implications for firms

Caroline Gallez  
*Facultes Universitaires Catholiques de Mons*  
Belgium

Our environment is subject to locally or globally defined damages. Governments have set up incentive systems or utilized command and control approaches to stop these damages and/or rehabilitate the environment. When dealing with pollution problems, one can observe that the former are in place in Europe and Japan in opposition to the United Nations of America where the latter is usually applied.

Some economists have theoretically studied the

respective characteristics of incentive systems and command and control approaches. Others have analyzed the consequences of these instruments on the basis of concrete examples. Some industries have received special attention: brewing, electric power, paper, chemicals, primary metals.

A synthesized overview of these major and/or interesting studies would be useful. That is the purpose of this paper, although restricted to the implications for these firms.

## A dynamic model with marketable discharge permits systems

Francisco De Sousa Ramos  
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Brazil

The utilization of standards as an instrument for environmental control is known as an inefficient policy [Baumol & Oates, 1988]. Market-based instruments (such as taxes, marketable discharge permits etc.) are seen as more efficient incentives for modifying the technology of firms. However, these instruments are always approached in a static context, that is, the objective is generally the determination of an optimum level of a control variable (limiting the quantity of marketable discharge permits, setting the level of effluents taxes etc.) But the adoption of an optimal policy like this may not be feasible if realized instantaneously: firms will have additional costs or additional constraints and may be expelled from the market.

In this paper, a mathematical model is used to show the feasibility of the adoption of an environmental policy where the control variable is gradually modified. The work focuses on the determination of a process that, through the succession of feasible stages, is able to bring this economy from an inefficient situation to an optimal state, utilizing a market-based instrument as a corrective mechanism. For this, we choose the marketable discharge permits system because, like taxes, they are efficient [Montgomery, 1972] and, furthermore, they are less influenced by uncertainty [Mallory, 1990].

We consider an economy with a public "bad": pollution. The overproduction of this good is corrected in a static context by using marketable discharge permits. In a dynamic context, we use this instrument to bring this economy from a *laissez-faire*

equilibrium (where firms are free to pollute) to an efficient state in the sense of Pareto. To achieve this: i) we characterize an efficient state; ii) we use stability analysis to simulate the evolution of this economy to the optimum; iii) and finally, we establish the main properties of the dynamic process (feasibility, individual rationality, convergence, stability). To do this, we take advantage of the development of the theory of economic planning which originated more than 50 years ago with Lange's [1936] and Taylor's [1929] works. The specific domain of such a theory is the calculation of the production and distribution programs, as well as the organizing of the exchange of information necessary to implement them. In this line of work we cite Malinvaud [1971] and Dreze-de la Vallee Poussin [1971]. Then, Tulkens and Schoumaker [1975] used the stability analysis to study the "polluters pay" principle in a pure exchange economy. See also Tulkens [1979], who treats the problem of transfrontier pollution, as well as Ramos [1992] and Mallory [1990], who expanded this model to the production of firms.

This paper is organized as follows. First, we present the various types of marketable discharge permits. Then, we present the structure of the economy with pollution, and we establish the conditions of a Pareto optimal allocation. Following, we will prove that in a situation of *laissez faire* this economy does not satisfy these conditions, but that interventions in different forms permit them to be satisfied. Finally, we ask how, starting from a non-optimal situation, we can arrive at an efficient one.

## **Solutions, strategies and new incentives: Danish experiences with cleaner technologies in the food processing industry**

**Arne Remmen**  
*Aalborg University*  
Denmark

Since the mid-80s an increasing number of Danish companies in the food processing industry have implemented cleaner technologies to prevent pollution at the source. Many of these projects have been carried out with partial financial funding from the cleaner technology programme in the Danish Ministry of Environment.

This article will focus on practical experiences and theoretical implications from the cleaner technology projects in fish processing industries, dairies and slaughter houses.

**Solutions:** Pollution prevention principles in food processing.

Different types of cleaner technology projects are reviewed which integrate product quality, environment and working conditions.

**Results:** environmental performance (change in resource consumption and emissions) and economic benefits.

**Assessment methods and environmental accounting** (at the company level).

**Strategies:** Many companies have changed their environmental strategies, because of growing environmental concerns of citizens, state regulators, suppliers, customers, insurance companies and so on. To the companies the most crucial change seems to be from a reactive compliance strategy to a proactive environmental management strategy.

Four categories of environmental strategies will be presented together with an overview on the internal dynamics and barriers.

**New incentives - dynamic regulation:** Traditional command-and-control regulation has very often resulted in implementation of end-of pipe solutions. This is one of the reasons why the danish environmental law has been changed, so the

regulators today have new possibilities in "commanding" cleaner technologies. These possibilities have especially been used to connect reactive companies with a compliance strategy.

New regulation "instruments" like certification, ECO-management and product labelling seems to be especially interesting to companies with a proactive strategy and can therefore create new incentives to keep up momentum in these kinds of firms.

Green taxes, change in market demands, greening of competitors are examples of new incentives influencing all kind of companies.

These different kind of new incentives will be analyzed in the Danish context.

**Perspectives:** The practical results and experiences from companies in the Danish food industry can be applied in many other countries. More than 50% of pollution and resource consumption can be prevented by changing working procedures or with very simple technical solutions at low cost.

This gives more attention to the fact that pollution prevention, and cleaner technologies must be given first priority over end-of-pipe solutions.

The theoretical implications are presented as:

- a set of assessment criteria on the environmental performance of companies with focus on eco-accounting
- four different environmental strategies for understanding internal dynamics and barriers to implementing cleaner technologies, and
- an overview of new incentives with special interest to countries with limited experience with traditional command-and-control regulation.

## **A critical analysis of current problems and proposed solutions with recommendations for public policy**

Haynes C. Goddard  
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Mexico

The solid waste management problem has moved rapidly to the fore of the national environmental agenda as evidenced by a flurry of legislative activity in recent years, most notably at the state level, designed to confront the problem of declining landfill capacity and rising costs of recycling and incineration. The rising tide of separated recyclable material at the local level is confronted by poor or nonexistent markets and is making recycling a very expensive activity, in some cases more than four times as expensive as landfill. This situation has prompted new calls to expand landfill capacity in the interest of cost-effectiveness. The same situation has led others to push for various recycling and reuse mandates to firm up the demand for secondary materials, and many states have responded. Nonetheless, the knowledge base (benefit-cost analysis) on which such mandates should be predicated is virtually nonexistent, a circumstance that raises the potential for serious policy errors. Germany's experience with the world's most restrictive packaging legislation is proving to be very costly, and recent evidence suggests that it may in fact be unworkable.

Our principal conclusions in summary form are:

1. A lasting solution to the solid waste management problem will be found only when there is a widespread recognition that the problem is not primarily one requiring just technical or engineering approaches such as landfill and incineration, but that fundamentally it is economic in nature. This means that the market and price system should be employed to help identify the proper balance among the various management alternatives of source reduction, recycling, incineration and landfill.
2. Because solid waste management ultimately involves all material flows through the economy, efficient and cost-effective solutions will require the

use of decentralized policy instruments rather than centralized mandates in order to permit full flexibility in materials use decisions.

3. Qualitative economic analysis suggests that command and control approaches will be rigid and not cost-effective, a conclusion that seems to be validated by the high cost of recycling mandates in the U.S. and in Germany.

4. The source of the solid waste management problem in the U.S. is due to the "short circuit" to the price mechanism for choices concerning materials use and reuse caused by local governments which provide waste management services at a zero price. It is "government failure", not "market failure" that is the source of the current problem.

5. The various proposals for upstream recycling and materials reuse interventions have either a weak or no foundation in economic analysis. They are arbitrary command and control... high and generate excessive business costs due to the inflexibility and imprecision that always characterizes centralized mandates.

6. There is a widespread lack of recognition that the cost of source reduction will be lower than any other management option for initial levels of control, derivative of a lack of understanding of how consumer choice and willingness to pay for solid waste management services should fit into the overall solid waste management plan.

7. The rapidly growing use of variable rates or user charges around the country is a trend that should be the focus of federal legislation and regulation to promote it as soon as possible, as this use represents a flexible national solution to the solid waste management problem. Local conditions would dictate the levels of the rates

## Creating the Institutional Setting for Sustainable Development

### Natural Resource Accounting & Sustainable Development

#### Panelists

1. Edgar Fürst: *Environment and resource accounting in Costa Rica: a critical balance and a preliminary solution*
2. Paul Craig and Harold Glasser: *Transfer models and explicit uncertainty: approaches to intergenerational "green accounting"*
3. Juan Antonio Aguirre: *Economic vrs. financial pricing of timber and its probable impact on national accounts: the Costa Rican case, 1980-1991*
4. Eberhart Seifert: *Practical consequences and applications of sustainability concepts to measure an environmentally adjusted national income*
5. Klaus Lidergaard: *Strict sustainability: towards a balance of environmental indicators: the case of Denmark in 1993*

Chair: Bruce Aylward, *IIEE/Centro Científico Tropical, Costa Rica*

#### Environment and resource accounting in Costa Rica: a critical balance and a preliminary solution

Edgar Fürst  
*Universidad Nacional  
Costa Rica*

The "*state of art*" in Environmental and Natural Resources Accounting for the purpose of National Accounts in Costa Rica is characterized by the fact that until now there exists only one attempt to take into account the natural capital depreciation caused by individual resource depletion (forest, soil, fishery), but without any concern for environmental degradation. This implies that the famous *Repetto* approach of net rent for assessing the depreciation cost of renewable resources still constitutes the core of accounting for nature. Its empirical results of "**Accounts Overdue**" in the case of Costa Rica is documented by the often cited study of the Tropical Science Center (CCT) and the World Resource Institute (WRI), that represents the outcome of the accounting work coordinated by Raúl Solórzano (1991, Spanish version: 1992).

But it is easy to show that the scope (and also the affirmative strength) of this work is limited. There is a self-constraining concern for only three renewables as well as a use of methods which are predominantly based on market price to determine the use of these resources or for their more or less market based substitutes.

The proposed paper aims to discuss these and other shortcomings of the CCT/WRI -approach for the case of Costa Rica. It will review the criticisms already raised and it will go on with a proper appraisal based on the recent debate about analytical and methodological assessment issues referring to natural resources and environmental assets in the context of Ecological Economics. In particular, the Paper will propose the basic features of an alternative

accounting framework (including the environmental concerns left out by Solórzano et al.) and will discuss - in a "way of feasibility-study" - the conceptual, technical, institutional and data conditions for undertaking more ambitious accounting in Costa Rica.

With that, the main purpose of the Paper will be to outline a research program as a first step to overcome the present shortcomings and failures of accounting for nature in Costa Rica.

### **Transfer models and explicit uncertainty: approaches to intergenerational "green accounting"**

**Paul P. Craig and Harold Glasser**  
*University of California*  
United States

Are we consuming nature or living on interest? To discuss this question, central as it is to any discussion of sustainability, requires developing improved indicators. "Green" indicators should enhance insight into both environmental and equity factors. Our viewpoint is that to accomplish this, accounting frameworks should emphasize disaggregated biogeophysical indicators and should be designed to facilitate analyses using a broad range of conceptual frameworks. We refer to the practical application of these conceptual frameworks as "transfer models", of which econometric approaches represent one important instance. A cornerstone of

the approach is the use of disaggregated data, structured so as to capture disparate views and to incorporate uncertainty explicitly. We emphasize the importance of considering a wide range of possible images of the future, then developing representative biogeophysical and equity indicators, and finally using these indicators with transfer models (e.g. economics, multicriteria techniques, risk analysis, etc.) to assess policies and perform resource allocation. We illustrate the methodology with a schematic example -- the impact of anthropogenic carbon dioxide upon global temperature, and hence on agricultural output.

### **Economic vrs. Financial pricing of timber and its probable impact in national accounts: the Costa Rican case, 1980-1991**

**Juan Antonio Aguirre**  
*Centro Agronómico Tropical de Investigación y Enseñanza*  
Cuba

Before the proper treatment of the externalities and the adequate identification of non-forest products from the tropical forest can be initiated, adequate pricing of timber resources is needed. The methodology makes use of nominal protection rates, world economic prices and estimates the economic valuation of total production, in terms of the forest sector's gross domestic product accounts and the

forest sector's participation in the total agricultural sector gross domestic product.

The results indicated that nominal protection rates estimated between 1980 and 1992 range from -81.58 to -89.79%, a situation that clearly indicates that substantial transfers from timber producers have been made to local wood consumers. The results

also showed that, had the timber produced during these periods been valued at its international economic or border price, then the share of the gross value of production of the forest sector in the gross domestic product of the agricultural sector for the same period would have experienced a share % increase from 4.155 to 26.7%.

The direct implications of such findings appear show: a) it is highly unlikely that resources which are so undervalued can motivate producers to care

for and manage them, b) a profound evaluation of the trade and commercial policies in the Costa Rican forest sector appear to be needed, c) the use of border prices would result in a larger policy voice for the sector, d) no use of externalities valuation could have overcome the real underpricing of the nation's timber resource, e) it would have meant a real increase in the economic revenue of local timber producers and a bigger concern for sustainable forest management.

### **Practical consequences and applications of sustainability concepts to measures of an environmentally adjusted national income**

**Eberhard K. Seifert**

*Wuppertal Institute for Climate, Energy and Environment  
Germany*

In the last few years, various authors and institutions have developed proposals for a modification of the traditional Gross National Product (GNP) concept according to the framework of sustainability.

Especially important for the debate on principles and methodologies of "green national accounting" for developed and developing countries are among others, for example, the concepts and perspectives of Solow, Repetto, Hueting, Daly, Pearce, Mäler/Common and UNSO (United Nations Statistical Office).

In the paper we will concentrate on the question of how to handle a sustainable national (income) product in the context of the degradation of "natural capital" (different from the depletion of natural resources).

More specifically, we will analyze first the question of the role of environmentally defensive expenditures in the various concepts. What is the rationale of one group of authors to opt for a deduction of (almost a part of) defensive costs from GNP and what is the rationale of an other group of

authors to argue for not deducting defensive expenditures from GNP.

The second question is how to value the degradation of natural capital by residuals of human production and consumption in economic terms. Our intention is to evaluate the methodological suitability and theoretical strength of the "avoidance cost" - method on the one hand and the necessary reformulation of the defensive costs-concept on the other.

In the last part of the paper we investigate the practical applications of concepts of environmentally adjusted national income (eco domestic or green national product) mainly made in developing countries under the guidance of UNSO, the Environmental Department of the World Bank and other organizations.

We will finish with the preliminary results of ongoing research on elaborating a handbook for green national accounting which we are working on jointly with partners from some European countries.

**Strict sustainability: towards a balance of the environment indicator:  
the case of Denmark, 1993**

Klaus Lindegaard  
*Aalborg University*  
Denmark

The sustainability steady state economy is characterized by high service and maintenance efficiencies and, hence, low throughput levels of matter and energy. The need for new and sustainable indicators in public policy and private decision making has in this connection become widely acknowledged, but there exists still much confusion and debate about the construction of "proper" economic indicators in this connection. The paper reflects this need and takes a pragmatic approach to the present problem of initiating changes in "the business as usual" practices by focusing on the maintenance efficiency of the resource and emission flows of the economy. This is done by making use of a very strict interpretation of sustainability and the construction of an annual balance of the environment account on this basis.

Sustainability in a strict sense implies a shift from the inter-generational perspective to an annual perspective on environmental damage generation and resource degradation. This annual flow is estimated

and given an uniform monetary valuation according to the related restoration costs necessary to secure that the population in question shouldn't be worse off in the following year. In principle, it is thus possible to estimate an annual environmental account balance by comparing annual damages and the annual amount actually spend by the community at large on environmental improvements and restoration.

The paper reports on an ongoing pilot study of the Danish economy along these lines, which is being done at Aalborg University, and which this summer will result in the Danish publication of "The Balance of Environment for Denmark 1993". The paper discusses the wider implications of preventive sustainable environmental policy strategies, the relation between the environmental balance account and the work on environmentally adjusted net national products and the data problems and obstacles which are present in the construction of economic indicators of sustainability.



## Creating the Institutional Setting for Sustainable Development

### Indicators of Environmentally Sound and Sustainable Development

#### Panelists

1. Alison J. Gilbert, Onno Kuik and Jan F. Feenstra: *An indicator of vulnerability: the combination of ecological and economic information*
2. James Kay: *An ecosystem basis for measuring sustainability*
3. Rudolph S. de Groot: *Identification of indicators for measuring sustainable use of environmental functions*
4. Peter A. Victor: *Categorizing natural capital*
5. J.R.E. Harger and F.M. Meyer: *Definition of indicators for environmentally sound and sustainable development*
6. Anthony M. Friend: *What needs to be conserved in a sustainable economy: an alternative approach to the objective function for indicators and policy*
7. Tim Turpin: *A working model for integrating indicators associated with ecologically sustainable development and those with research and economic development*

**Chairs:** Glenn-Marie Lange, *New York University, United States*  
J.R.E.Harger, *UNESCO, Indonesia*

#### An indicator of vulnerability: the combination of ecological and economic information

Alison J. Gilbert, Onno Kuik and Jan F. Feenstra  
*Institute for Environmental Studies*  
The Netherlands

Environmental and economic statistics, in particular those envisaged for use in environmental accounts and in the construction of environmental indicators, are (to be) collected on a regular basis, documenting regular economic and environmental activity. However, some activities occur not only irregularly, but also unpredictably (particularly in space and time) and with uncertain economic and/or environmental accounting and indicator development; e.g. the *Exxon Valdez* and Bophal accidents. Considerable effort is directed towards prevention and/or amelioration of the effects of such events. *Ex ante* documentation of the risks of occurrence and uncertainties of effects is desirable in the light of reasonable expectation that such accidents will

occur. This documentation can be used in the subsequent planning of defense strategies.

The purpose of accounts and indicators in such circumstances is to guide investment into and subsequent allocation of defensive resource. More specifically, they should perform the following functions:

- provide feedback and interaction among prediction, possible impacts and defense planning;
- Calibration and validation of models for such prediction; and

- ongoing evaluation of the costs, benefits and effectiveness of defense strategies.

This paper discusses the development of an indicator which presents the vulnerability of the Dutch coastline to a major oil spill. Such an indicator

supports the first function above. Vulnerability comprises both economic and ecological aspects via the impact of oil on, for example, tourism and habitats. Crucial to this indicator's construction is the combination of economic and environmental information expressed in different units.

## An ecosystem basis for measuring sustainability

James J. Kay

*Environment and Resource Studies, University of Waterloo  
Canada*

Several people (Costanza, Hannon, Folke, Kay) have suggested that the best model of a sustainable system in a given area is a mature healthy ecosystem. While there is much debate about what sustainability means, its essence is the ability to maintain a bio-physical entity as a self-organizing system, indefinitely. What this entity should be and what it means to maintain it as a self-organizing system with permanence is the subject of the debate. Regardless of the position one takes in these debates, ecosystems with integrity are sustainable.

So what can we learn about sustainability of eco-eco systems from understanding what makes for a mature healthy natural ecosystem? To begin we must explore what self-organizing systems are about. Fundamentally self-organization is about using energy and material to maintain structure. As Prigogine pointed out this means that self-organization is fundamentally about thermodynamics and in particular the second law. Self-organization is the

process by which high quality energy (exergy) is captured by a system and used to obtain material resources, convert them to structure and operate a system. Understanding of this process, as Schneider has pointed out, requires a thermodynamic perspective which focuses on the space, time, energy and information attributes of the system. We have investigated self-organization and integrity of ecosystems from a thermodynamic perspective, that is as entities which maximize their use of the exergy in the energy available to them. This has led us to propose a number of measures of ecosystem development and integrity. In this paper we will explore the implications of these insights about ecosystems as self-organizing entities for the sustainability of eco-eco systems. In particular we assert that current approaches to analyzing the sustainability of eco-eco systems fail to take into account the realities of the second law of thermodynamics, that is changes in quality, and hence cannot succeed.

## Identification of indicators for measuring sustainable use of environmental functions

Rudolf S. de Groot  
*Agricultural University Wageningen*  
The Netherlands

Many definitions exist for the concept of "sustainable development". In this paper it is argued that sustainable development should be defined specifically in terms of ecological, socioeconomic and cultural sustainability. Ecological sustainability could then be defined as "the natural limits set by the carrying capacity of the natural environment (physically, chemically and biologically), so that human use does not irreversibly impair the integrity and proper functioning of its natural processes and components". An important element in this definition is the concept of environmental functions which is defined as "the capacity of natural processes and components to provide goods and services that contribute to human welfare, directly or indirectly".

In this paper, the link between environmental functions and indicators for their sustainable utilization will be elaborated and presented in a conceptual framework. After a general introduction

on the type of indicators that can be used to measure sustainable use of environmental functions, the paper will focus on the ecological indicators and their relation to four main types of environmental functions: 1. regulation functions (maintenance of essential ecological processes), 2. carrier functions (the spatial use of the environment), 3. production functions (harvesting natural resources) and, 4. information functions (the aesthetic and inspirational value of nature).

Depending on the type of function, different indicators will be needed to assess their availability and to set standards (qualitative, quantitative and spatial) for their (maximum) sustainable use. The paper will close with some examples of sustainability indicators for the use of environmental functions provided by specific natural ecosystems (including tropical rainforests).

## Categorizing natural capital

Peter A. Victor  
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Canada

A necessary condition for sustainable development is that the capital stock of a society be maintained from one generation to the next. Such capital consists of manufactured capital, human capital and natural capital. It follows that indicators of sustainable development should measure changes in the capital stock.

Measurement of natural capital requires that it be divided into categories that are based on a sound definition of natural capital and which are each capable of measurement. While traditional capital

theory gives some clues as to the definition and measurement of natural capital, there are other concepts and ideas from other fields that are essential for a satisfactory understanding of and assessment of natural capital.

This paper will examine natural capital in light of traditional capital theory. It will then review and compare alternative conceptual frameworks for defining and categorizing natural capital for the purpose of deriving indicators of sustainable development. The paper will go beyond the author's

previous work on the relation between capital and sustainable development, to include material from resource and environmental economics, recent work on incorporating environment and resources in

national income accounts, and into largely non-economic work on state of the environment reporting and systems definitions of sustainability.

## Definition of indicators for environmentally sound and sustainable development

J. R. E. Harger and F. M. Meyer

*UNESCO, Regional Office for Science and Southeast Asia  
Indonesia*

The definition of ESSD indicators is now considered to be very important for the identification of progress in environmental activities in developing and developed countries. The UNCED Conference in Brazil in 1992 has had a great influence in the activities concerning environment by stressing the need of global action in this field. To be able to compare and correlate actions undertaken in environment now there is a requirement for the definition of a scale against which such actions can be measured and verified. In order to create such a scale, indicators for sustainable development will have to be identified.

UNESCO/ROSTSEA is actively involved in defining ESSD indicators in south and southeast Asia. This is being done in cooperation and consultation with all UN agencies actually concerned with the process of development in the region. The forum for cooperation is coordinated by ESCAP (Economic and Social Commission for Asia and the Pacific), a UN body in Bangkok, which covers the regions of Asia and the Pacific. In 1990 ESCAP formed an Inter-agency Committee on Environment and Development (ICED). As part of this work program the ICED has established a working group to

define a list of ESSD indicators to be used as a common framework for evaluating development activities in terms of environmental issues. During meetings of this working group, the UN agencies actually involved with the issue provided suggestions which were then analyzed by UNESCO and combined to a preliminary outline of ESSD indicators.

A structure to organize potential indicators was presented by UNESCO at an early meeting of ICED. This structure envisages that the dominant environmentally-related processes which are to be considered in the development of quantitative indicators should be grouped and limited. The input of all UN agencies have been analyzed in order to compare the suggested ESSD indicators using the UNESCO outline covering dominant environmental processes. A summary was then created which takes into account the suggestions made by the different UN agencies. The summary areas wherein ESSD indicators may be constructed is provided below. Revision will be required in order to cover all indicators and to reach consistency in all subtopics. At least one measurable characteristic will have to be defined within each of the listed categories.

## **What needs to be conserved in a sustainable economy: an alternative approach to the objective function for indicators and policy**

**Anthony M. Friend**

*Institute for Research on Environment and Economy  
Canada*

Sustainability requires knowledge of properties of resources that need to be conserved in order to sustain future production of goods and services. The concept of capital provides the notional link between past production and future consumption. In classical economic theory capital is defined in terms of a fund (or stock) which, in combination with entrepreneurship, mobilizes labor and machines to make salable commodities at a profit. The surplus of which is then returned to the original fund. It is thus the capacity to create this surplus that defines the "objective function" for further economic growth, and ipso facto economic policy. Ecological economics has expanded this notion to natural productivity (i.e., the capacity to reproduce) and the conservation of natural and cultural assets. This paper explores conservation principles in science and their application in public policy, (i.e., what must be conserved in order to sustain a desirable level of future consumption). The properties of concern are those of invariance in a world of continuous change. These might be referred to as symmetries (or patterns) that remain unchanged

in a process of transformation. The classical notion of "fund" is of this kind, (i.e., invariant with respect to changes in technology, labor, and resource inputs). Can we identify similar symmetries in natural and cultural capital? If so, can their conservation be defined as an objective of public policy? Symmetry is a well defined concept in mathematics and, of course, is an inherent property of physical laws, (i.e., invariance in Universal time/space). In addition the concept, even among the hard edged sciences, alludes to aesthetic properties of balance and beauty. While the latter aspect might inspire public policy the measurable elements of symmetry must, nonetheless, be the basis for the research agenda of Ecological Economics. Currently indicators of sustainability are either "fuzzy sets", such as the margin between manmade production and "environmental" carrying capacity" or are indicators of environmental stress, such as level of recycling. It is maintained in this paper that symmetric properties of resources, cultural and natural, are a more robust basis for indicators of sustainability and further, their conservation is the bottom line "objective" of public policy.

## **A working model for integrating indicators associated with ecologically sustainable development and those associated with research and economic development**

**Tim Turpin**

*Centre for Research Policy  
Australia*

Governments throughout the Asia-Pacific region during the 1990s are increasingly seeking ways to develop national research policies that target national socio-economic objectives within an overall framework of ecologically sustainable development (ESD). However, the concept of ESD varies from country to country and so, too, do the national

indicators that account for national economic, research and development data. The Australian government has recently commissioned the Centre for Research Policy (CRP), also Regional Centre for STEPAN, the UNESCO Science and Technology Policy Asian Network, to carry out a study to develop a working definition of ESD and to develop indicators

for assessing the nature and level of national research relevant to ESD.

During the past few years and under the auspices of STEPAN, the Centre for Research Policy has been involved with the 18 member countries throughout the Asian region in developing indicators

and information systems for monitoring and driving national research policy and its connectedness to socio-economic development. Empirical findings of the Australian study that integrates ESD indicators into research and socio-economic development indicators will be presented and related to the experience and indicator needs of other countries throughout the Asia-Pacific region.

## Creating the Institutional Setting for Sustainable Development

### Sustainable Technologies and Institutions

#### Panelists

1. Alexander E. Farrell: *The ecological and ethical implications of emission permit systems: sulfur dioxide permit trading in the United States*
2. Ger Klaassen: *Sustainability, joint implementation and the control of sulfur emissions in Europe*
3. Ricardo Manso: *Economic and ecologic analysis of change in rainfall patterns*
4. Clóvis Cavalcanti: *Living with the limits of the possible: sustainable alternatives of the Amerindian lifestyles*
5. Astad Pastakia: *Endogenous technological innovation for sustainable development: the case of agricultural pest management*
6. Kirit K. Patel, Shilesh Shukla, Vijaya Sherry Chand, Astad Pastakia, Jitendra H. Suthar, Jyoti Capoor and Anil K. Gupta: *Efficiency of indigenous ecological knowledge system for sustainable natural resource management*
7. Aseem Pakrash and Anil Gupta: *Institutions and environmental sustainability reflections on ecological economics*

**Chair:** Anil Gupta, *Indian Institute of Management, India*

#### The ecological and ethical implications of emission permit systems: sulfur dioxide permit trading in the United States

Alexander E. Farrell  
*University of Pennsylvania*  
United States

Market-based environmental regulation has been recommended by economists for many years, and is being used increasingly throughout the world. The largest example so far is the acid rain reduction program contained in Title IV of the U.S. Clean Air Act Amendments of 1990 (CAAA). A very different market-based program is the Alternative Fuel Vehicle (AFV) credit system created by the Energy Policy Act of 1992 (EPA). Most business leaders, numerous policy makers and some environmentalists agree that such techniques are useful, but many critics express deep concern about their effectiveness and fairness. The proposed paper will address both critiques.

The proposed paper has two sections. The first will examine the standards that all market-based environmental regulations should meet, using Herman Daly's framework of Efficiency/Equity/Scale as well as specific criticisms that have been raised about such programs. The ability of market-based environmental regulation to meet these requirements in theory will be addressed; in essence a discussion of how to properly design market-based environmental regulation.

The second part of the paper will consist of an examination of the sulfur dioxide emission permit

trading system created by the CAAA and the future AFV credit program. The legislative text, resultant regulatory language, and the actual outcomes observed to date will be compared to the standards and critiques discussed in the first part of the paper. The regulations for the AFV credit system are not yet

written, so only the legislative text will be examined. These two very different forms of market-based environmental regulation should provide a very rich context in which to extend into practice the analysis of ecological economics.

## **Sustainability, joint implementation and the control of sulfur emissions in Europe**

**Ger Klaassen**

*International Institute for Applied Systems Analysis  
Austria*

Joint implementation of emission ceilings is an important topic on the current negotiations on a second sulfur protocol in Europe, to be signed in June 1994. Whereas the current protocol stipulates uniform reductions, national emission ceilings included in the new protocol imply differentiated reductions. The new protocol explicitly takes the sustainability of ecosystems as a starting point. Levels of acidifying sulfur deposition have to be cut such that levels of deposition do not exceed the critical loads: levels of deposition below which no damage is expected to occur. This sustainability approach is combined with a precautionary one, using the best available technology not entailing excessive costs. This paper now examines to what extent the joint implementation of national emission ceilings might improve cost-efficiency without jeopardizing ecosystem sustainability. A new element is that joint

implementation is a complement to technology based regulations. Calculations are made using the RAINS (Regional Acidification Information and Simulation) model covering 38 regions in Europe. The results suggest that overlaying joint implementation on regulations does reduce its cost savings but has beneficial impacts as well: the overall level of ecosystem protection is not changed and significant decreases in environmental benefits for some countries are largely avoided. Joint implementation can, however, also be used to increase ecosystem sustainability. If combined with existing regulations, this also minimizes losses in expected ecosystem sustainability for some countries and most countries gain. In this case, the initial distribution of national emission quota, however, has to be used to avoid that some countries are confronted with higher costs.

## **Economic and ecologic analysis of change in rainfall patterns**

**Ricardo Manso, Mario Valdés, Aida Atienza**  
*Sociedad Meteorológica  
Cuba*

Cuba depends on water because its' economic base is agricultural (sugar cane, citrus fruits, etc.). Rainfall, the main source of water, has a large space-time variability; drought is one of its most common characteristics.

This situation has encouraged an extensive water management policy, including practical and experimental efforts to increase rainfall (i.e., artificially sowing convection clouds with silver iodide). More than ten years of experience has



shown that it is possible to obtain additional volumes of water for each cloud unity stimulated. This fact encouraged, some years ago, another study of the impact of a regular program to increase rainfall, known as artificial rain. The study examined the economy and ecology of a region that was subjected to this intentional human action. The identification of the main environmental factors that were affected by cloud sowing, and the preparation of approaches to evaluate the changes in the rainfall pattern, have helped us to understand that we could extend the analysis to include the unintentional influences of

humans on their natural environment.

This paper utilizes methodologies which can be applied to ascertain previously unnoticed modifications of natural variability, starting from studies about the impact of artificial modification of weather patterns. In addition, some links are established between the tropical cloud systems and their rainfall, and the economic-ecological factors in a particular territory in accordance with Cuba's experience.

### Living within the limits of the possible: sustainable alternatives of the Amerindian lifestyles

Clóvis Cavalcanti  
*Institute for Social Research*  
Brazil

It is extraordinarily important to those studying ecological economics to try to understand distinct life systems which differ in terms of patterns of sustainability, consumption levels, society-nature relationships, the preservation of biodiversity, and so on. Within an ecological economic perspective, two extremes of such systems can be identified in the American continent. In terms of the use made of nature, the U.S. system represents an extreme of resource voracity with limited results for the enjoyment of life (Daly & Cobb 1989). On the other hand, an extreme of enormous respect for the laws of nature and practice of thermodynamic thrift is found among Amerindian tribes – such as the Araweté and the Yanomami, e.g. – still enjoying harmonious lifestyles (Viveiros de Castro 1992) in the Amazon. Rules of sustainability clearly prevail in the Indian system, much in contrast with the unsustainability feature inherent in the American patterns. The Indians live within the limits of the possible, slowing down the energy flow and the dissipative tendency of the second law of

thermodynamics. If ecological economics is the science and management of sustainability, the Indian paradigm is to be seriously taken into account, for it – according to Reichel-Dolmatoff (1990) – reveals to us the possibility of an option (on an intellectual level). It is certain that economic growth is nonexistent among the Indians. And if, as The Economist (1993) puts it, "to join the rich world means to acquire the ability to grow indefinitely", the Indians' paradigm collides with the growthmania ethos. The present paper, which is part of a study in progress, tries to combine evidence from the work of anthropologists, ethnologists, ethnoscientists with ecological economics in order to delineate a proven pattern of sustainability which exists concretely. The idea is to explore experiences in the field of EE which were carried out without the specific aim of testing principles from that discipline, experiences that contain, however, important meaning as sustainable alternatives.

## **Efficiency of indigenous ecological knowledge systems for sustainable natural resource management**

**Kirit K. Patel, Shilesh Shukla, Vijaya Sherry Chand,  
Astad Pastakia, Jitendra H. Suthar,  
Jyoti Capoor and Anil K. Gupta**  
*Indian Institute of Management  
India*

Different perceptions of nature at grassroots levels generate categories of sense making among different social groups. These categories provide clues for understanding how social ecological interactions evolve over time and space. Social ecological paradigms help in understanding how ecological endowment and access to factor and product markets, kinship networks, etc., shape the portfolio choices of the households.

The paper describes the way these portfolios are managed in different risky environments through

creative and innovative resource use strategies. The policy implications for supporting this creativity are drawn in the end. It is argued that entrepreneurial development at grassroots level cannot take place unless perception of nature, category of sense making, strategies of creative resource use and available institutional choices are not seen in a comprehensive manner. The sustainable outcomes for resource management situations require widening the decision making choices and elongating the time frame.

## **Institutions and environmental sustainability reflections on ecological economics**

**Aseem Prakash and Anil K. Gupta**  
*Indian Institute of Management  
India*

Humans have increasingly become the dominant specie on this planet and there is a breakdown of balance-of-power amongst the various species and generation. This dominance is critically dependent on an energy intensive life style which entails an excess demand on nature for both the supply of low entropy structures as well as for the recycling of the high entropy externalities. This is the crux of the ecological crisis which can be traced to how relationships in nature have evolved and been ordered. Four levels of ordering relationships in nature (Moral, Ecological, Social and Physical) and how the various inter-specie and intra-human

relations may evolve (spontaneous, negotiated, and imposed) are identified. The moral ordering and the ecological ordering of neo-classical and new-institutional economics are highlighted and their implication for environmental sustainability is sketched. Ecological economics is examined as an alternative way of viewing how the world operates. The complexities involved in the pursuit of three macro goals of efficiency, equity, and sustainability are discussed. Finally, the Rawlsian "veil of ignorance" is proposed as the guiding principle to construct inter-specie and inter-generation relationships.

## Creating the Institutional Setting for Sustainable Development

### Financial Mechanisms to Achieve Sustainability

#### Panelists

1. Ronnie de Camino: *The internal effort to finance sustainable development. Reality or utopia?*
2. Herman Rosa:
3. Frank Müller: *Ecological realpolitik: the necessity of international transfer payments to developing countries for environmental protection*
4. Luis Ferraté:
5. René Castro:

Chair: David Kaimowitz, *Inter-American Institute for Cooperation on Agriculture*, United States

#### The internal effort to finance sustainable development. Reality or utopia?

Ronnie de Camino V.  
*IICA/GTZ Project*  
Chile

Agenda 21 states very clearly that the major source for funding the way to sustainable development must come from the internal efforts of each country, including obviously the developing countries. It also states that international assistance can only complement such efforts, not provide the major source of finances.

The paper discusses the need countries have to trace their own path to sustainable development. A path based on values, tradition, experience and realism, trying first to avoid non-sustainable developments to progress in order to move gradually to a more sustainable situation in the future. Developed countries and the international system must respect this approach and negotiate the time frame and mechanisms without undue pressure.

The likelihood that poor countries can finance Agenda 21 activities is analysed and some alternatives of internal funding are given, such as eliminating perverse incentives and re-allocating funds to foster sustainability, pricing natural resources products and services, joint ventures

enabling developing countries to capture a major proportion of the rent in production processes originating in raw materials and natural resources, etc. It also discusses the willingness to pay for environmental products and services in societies both from the north and from the south. It gives some concrete examples of funding arrangements.

The paper also states that the need for external funding is still there, but that developed countries are not matching their contributions or they are asking for too many pre-conditions to release funds for sustainable development.

Finally, this paper develops the idea that loans from the multilateral financing system should be considered an internal effort since they are credits that must be paid in the future. The thesis is supported that the bilateral and multilateral financial system needs to develop mechanisms to fully transform themselves into a banking system for sustainable development.

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## Creating the Institutional Setting for Sustainable Development

### Pesticide Issues and Ecological Economic Answers

#### Panelists

1. Douglas L. Murray and Elizabeth Nathan: *From pesticides to IPM: an analytical framework for sustainable development in the Caribbean Basin*
2. Ron Janssen: *Geographical information and decision support: an application to the admission of pesticides within the European Community*
3. Geoffrey Kerr: *Ecology, economics and allocation of a pest control budget*
4. Lory-Ann Thrupp:
5. Ineke Wessling:

Chair: Luisa Castillo, *Universidad Nacional*, Costa Rica

#### From pesticides to IPM: an analytical framework for sustainable development in the Caribbean Basin

Douglas L. Murray and Elizabeth L. Nathan  
*Colorado State University*  
United States

Technology transfer remains a central feature of international development strategies. From the Green Revolution to UNCED's proposals for a more sustainable future, technology transfer has been a cornerstone of development efforts worldwide. But the factors which fostered the diffusion and adoption of advanced technologies over the past half century may no longer be compatible with the needs and vision of the South as it looks for alternative courses of development. Development planners in both the North and South will likely need to make fundamental shifts in their notions of development, particularly in the role of technology, if development efforts in the future are to be more lasting and sustainable than they have been to date.

To demonstrate the need for such changes, we explore the course of agricultural development in the Caribbean Basin in recent decades and the reliance on two different pest control paradigms, pesticide-intensive farming, and the use of Integrated Pest

Management (IPM). IPM has been shown to be a viable alternative to pesticides in a wide range of crops in the developing world. Yet after several decades of promoting IPM technology, it remains marginal to most farming systems. Pesticides, in spite of their widely recognized detrimental effects, remain the dominant pest control technology, leading to the question: Why, in the face of such extensive evidence of its *ecological* and economic destructiveness, has pesticide technology persisted in Third World agriculture? Conversely, why has IPM, with its demonstrated range of more beneficial and sustainable *characteristics*, failed to be adopted in the majority of *Third World settings*? This paper provides an analytical framework for understanding the obstacles and opportunities encountered in the diffusion and adoption of these competing paradigms as a means of exploring the prospects for more sustainable agricultural development strategies in general.

## **Geographical information and decision support: an application to the admission of pesticides within the European Community**

**Ron Janssen**  
*Institute for Environmental Studies*  
The Netherlands

Geographical information systems have made spatial data available for environmental decision making. This information is usually processed by map presentations. In this paper we try to process this information using techniques developed within management science.

A decision support system for the admission of pesticides in countries of the European Community is presented. Essential for the design of any decision support system is a clear identification and definition of a) the decision, b) the decision maker and c) the criteria and decision rules.

### **A. The decision**

According to the definition of the alternatives the following division can be made: 1. admit or do not admit a pesticide, 2. Admit a pesticide only for certain regions, 3. admit a pesticide only for certain types of use; or 4. admit a pesticide for a limited period.

### **B. The decision maker**

Decision makers can be at the european, national, regional, local level and in last instance at the level of the individual farm.

### **C. The decision criteria and decision rules**

Many criteria play a role in the decision process on admittance of a pesticide. Some examples are: costs, effectiveness, health risks, risks for groundwater, risks for protected areas (e.g. water catchment), risks for vulnerable regions, risks for endangered species, etc. The importance of each criterion will depend on the type of decision and decision maker. A value function links the level of a physical parameter, for example the concentration of a pollutant in the soil to the importance score on a scale between 0 and 100. The shape of value functions can be determined using expert judgement. Value functions are used in this project as a substitute for dose effect relations that are not available.

## **Ecology, economics and allocation of a pest control budget**

**Geoffrey Kerr**  
*Lincoln University*  
New Zealand

Brush-tailed possums (*Trichosurus vulpecula*) were first successfully liberated in New Zealand in 1858. Forest areas in New Zealand have subsequently been severely modified by possum browsing with the death of possum-favored flora species. The consequent habitat destruction is affecting indigenous fauna populations. Possums also transmit bovine tuberculosis to cattle and deer.

Analysis of possum control policy is complicated by the fugitive nature and wide geographic distribution of the pest. It is not appropriate to treat individual areas of forests in isolation.

Resource constraints mean that only some areas can be protected from damage by possums, it is therefore important to know where forest protection

efforts will provide the greatest benefits. Some information is available on the costs of protecting vegetation from damage by possums, but almost nothing is known about the benefits obtained from vegetation protection. At present, areas are ranked for protection by reference to an index of biological characteristics. This approach does not provide information on the benefits obtained from protection.

Factors important to the public for prioritising areas for possum control are found by direct questioning. A contingent valuation approach is used to identify the role of perceived site characteristics in determining the value of possum control.

Stated factors are found to differ from those identified in the contingent valuation approach and are supportive of the present approach to prioritising areas for possum control. Willingness to pay for forest protection is strongly influenced by the importance and status of a small number of perceived forest characteristics which differ from those in the current "ecology-based" criteria for prioritising areas for possum control. Findings indicate that the current budget allocation method is inefficient. A new approach to cost-effective allocation of possum control budgets, which allows simple incorporation of public preferences, is proposed.

## Financing Sustainable Development

The concern for environmental degradation, particularly in the developing world, is tempered by the social goal of raising the standard of living. If the global effort to safeguard what remains of the biosphere is to be successful, a major commitment to providing the financial support for achieving sustainability is essential. This theme will focus attention on the responsibility to provide the financial resources to achieve sustainability.

### Panelists

1. Marc Dourojeanni, *Inter-American Development Bank, United States*
2. Osvaldo Sunkel, *Center for Latin American Studies, United States*
3. Karl-Henrik Robert, *The Natural Step Foundation, Sweden*

Chair: **Juan Martínez-Alier, Universidad Autónoma de Barcelona, Spain**

### Creating the institutional setting for sustainability

Marc J. Dourojeanni  
*Inter-American Development Bank*  
United States

#### Assumptions:

1. We do know what sustainable development is. What is it?
2. Sustainable development means better quality of life, higher security for people and less emphasis in growth.
3. Sustainable development also implies equity among people, countries and regions.
4. It is worthless to even think about "institutions for sustainable development" if there is no political will. Is there any? What are its expressions?

Foundation of institutions for sustainable development

1. *Is there any real difference among institutions for development and institutions for sustainable development?* If the answer is no, the issue is, simply, to have good institutions. Therefore, all past and current good and bad experiences with institutions are valid examples. Is this true? If the answer is yes... What are these differences?
2. *Participation* What is participation? Participation of whom? Benefited or affected population or their representatives? Who are these representatives? The political representatives of NGOs? What kind of NGOs should participate in what?
3. *Authority* or authority with participation or participation without authority.



4. Is "participation" of NGOs a mean or a tool? Would NGO participation be necessary if democracy was working well? Are NGOs democratic institutions? Probably some yes and some not...
5. *Decentralization and desconcentration of decision making*: definition of both concepts.
6. *Adequate legislation* What would be "adequate" legislation? How to use wisely the principle of the carrot and the stick? How to have a much more flexible, locally adapted, legislation... How to apply the principle that "lo perfecto es enemigo de lo bueno".
2. *International agreements*. Not adapted to each signatory country and even less to the local reality in each part of the countries.
3. *Adaptation to emergencies*. The future will bring more and more environmental "emergency" situations.
4. *Complexity*. Most of the tasks of these institutions will be coordination with other agencies.

#### Solutions

#### Challenges for the new institutions

1. *Globality*. National institutions will, every day more so, think and act globally. They shall care as much for national public opinion as for international public opinion. It is going to be much more difficult!
1. Deep reform of the international institutions systems, especially the United Nations, the regional systems and the MDBs.
2. Clarification of the role of the NGOs.
3. Improvement of the quality of democracy.

### Sustainable development: from words to funds

Oswaldo Sunkel  
Center for Latin American Studies  
United States

There is a dramatic gap between heightened ecological awareness and knowledge, and effective environmental action. This gap will probably widen as the former grows exponentially, spurred by the threat of looming crises, while the latter drags along, neglected by neoliberal economic policies, which are future-blind and equity-deaf.

Environmental action requires a substantial increase in the allocation of economic resources. This requires political will and a change in priorities, criteria and procedures. In order to achieve these, a Fund for Environmental Sustainability is proposed, with special characteristics aimed at the ecological, social and ethical objectives of sustainable development.

## Socio-ecological principles for a sustainable society

Karl-Henrik Robert, John Hokmberg and Karl-Erik Eriksson  
*The Natural Step Foundation*  
Sweden

A long-term sustainable global society must have stable physical relations to the ecosphere. This implies sustainable material exchange between the society and the ecosphere as well as limitations on society's manipulation of nature. Physically, sustainable development then means (i) development towards such a sustainable relation and, after this has been reached, ii) development within the boundaries of sustainable exchange.

We apply a system perspective and put our focus early in the causal chain. From the condition of stationarity, we derive four principles for a sustainable society. The first principle deals with the exchange of substances with the lithosphere, the second principle concerns substances produced within society, the third principle deals with the manipulation of the ecosphere and the fourth principle with the societal metabolism and production of services to the human sphere.

The socio-ecological principles thus deal with the physical limits for society (Daly's Plimsoll line) and the physical efficiency of society within those limits. But these concepts are meaningful only if related to purpose and value. The values that must be honored in a sustainable society are *human value* and the *value of life on Earth*. The first implies that human dignity and justice are societal goals. The second implies that life and life-supporting systems are valued in their own right and *not only* for their support of the human society.

These four socio-ecological principles have been worked out in close contact with a wide pedagogical practice. They have been found to function well in teaching situations and many actors within business and local administration have adopted them as the basis for their strategies towards sustainable development.

## New Perspectives

Problem solving of the magnitude facing the ecological economics community will more than likely lead to the creation of entirely new ways of approaching familiar issues. This theme will examine innovative approaches to the social and ecological challenges we face as we enter the 21<sup>st</sup> century.

### Panelists

1. Larry Smarr, *University of Illinois*, United States
2. Joseph Tainter, *Rocky Mountain Forest & Range Experiment Station*, United States
3. Paul Ekins, *Birkbeck College*, United Kingdom

Chair: Juan Martínez-Alier, *Universidad Autónoma de Barcelona*, Spain

### Are complex societies sustainable? Perceiving fundamental issues

Joseph A. Tainter  
*Rocky Mountain Forest & Range Experiment Station*  
United States

Sustainability is the fundamental issue for every complex society. So many societies known to history and archaeology have collapsed that it is an open question whether any complex society can persist indefinitely. For the members of industrial societies all questions should be subordinate to sustainability, yet discussion of this ultimate issue tends to be restricted to small numbers of intellectuals. Practical solutions to ecological problems must confront the social, ideological, and economic constraints that prevent us from addressing sustainability on a society-wide basis. These constraints include: a) our singular divergence from most of economic and political history, and the

resulting influence on how we socialize our young; and b) fundamental economic constraints to what is often assumed to be the solution to problems of sustainability: applied research and development. Ecological approaches to either macro or microeconomic problems that do not address these constraints cannot be considered practical. Although this dilemma is critical, there are hopeful aspects to it. While our unique historical situation may predispose us not to understand fully the nature of our problems, it also confers upon us a unique potential for self-understanding that is essential to sustainability.

## **An economics for sustainability**

**Paul Ekins**  
*Birkbeck College*  
United Kingdom

The economic method of analysis consists of allocating monetary values to the costs and benefits of a particular activity in order to arrive at a benefit-cost ratio to inform decision-making. Where this ratio is greater than unity, there is usually a presumption that the activity is beneficial and, at least in principle in a rational society, should be encouraged. It is well known that this method can lead to an "optimal" outcome that involves the extinction of species or a level of environmental degradation that violates conditions of environmental sustainability.

One response to such outcomes is to consider that the monetary valuations of the costs of the unsustainable outcome were too low. In a society that gave priority to sustainability, it may be argued,

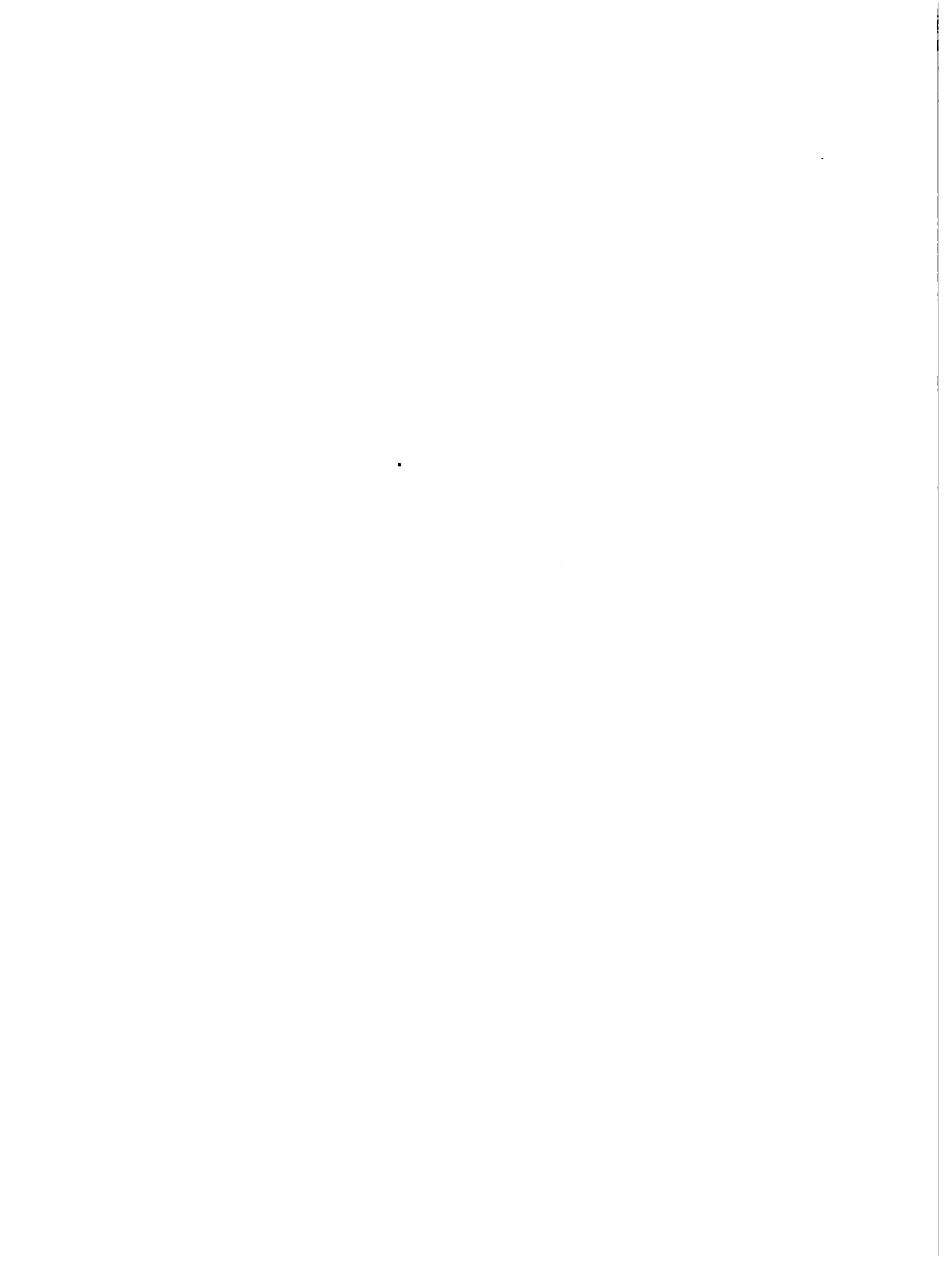
"proper" valuation would ensure that activities involving unsustainable outcomes would not be economically viable. This might indeed be the case. However, in practice it is unlikely that techniques can be produced which do not leave themselves open to manipulation by interested parties.

An alternative approach would be to seek to embed the economic analysis within an ethical and physical framework that postulated a moral obligation on current human generations to respect conditions of environmental sustainability and that defined those conditions in biophysical terms. Economic analysis would then be useful in exploring how these conditions could be complied with using a least cost principle. The paper will develop this alternative approach in more detail.

**D**isplay

**A**rea

**P**resentations



## Stand 1

### **An analysis of the Himalayan environment and guidelines for its management and ecologically sustainable development**

**Afroz Ahmad**  
*G.B. Pant Institute*  
India

The impacts of human activities on the biogeophysical and socio-economic environment of the Himalayas are analysed. The main human-induced activities which have accelerated ecological degradation and threatened the equilibrium of Himalayan mountain ecosystems are stated as: unplanned land use, cultivation on steep slopes, overgrazing, major engineering activities, over-exploitation of village or community forests, lopping of broad leaved plant species, shifting cultivation (short cycle) in north-east India, tourism and recreation. Monoculture in forests, erosion and landslides have resulted in one-third of the total Himalayan land area becoming environmentally derelict. Cold desert conditions prevail in 41,500 km<sup>2</sup> of north-west Himalayas and are encouraged by traditional pastoralism. The geo-morphological conditions are major factors responsible for landslides

which cause major havoc every year in the area. Other physical problems exist, such as eutrophication, drying up of the natural springs, the recession of the glaciers and changes in surface and ground water hydrology. Wild fauna, like musk deer (*Moschus moschiferus*) and the snow leopard (*Panther uncia*), are now under threat partially due to changes in their habitat and the introduction of exotic plant species. Population pressure and migration are major factors responsible for poverty in the hills. The emigration of the working male population has resulted in the involvement of women as a major work-force. This work includes trekking for hours to collect fodder, timber and drinking water in addition to household duties. Guidelines, with special emphasis on the application of environmental impact assessments for the management of the Himalayas, are proposed.

## Stand 2

### **Social variables, economic development, and environmental problems in El Salvador**

**Ricardo Lira**  
Chile

Social variables, like poverty and demographic pressure, are among the main causes of environmental deterioration in El Salvador. It is said that poor people are, in most cases, both the main victims as well as the main agents of environmental degradation. When low income levels are combined with a high population density, or its accelerated growth, the most difficult conditions for

environmental conservation are produced in a specific physical context.

On the other hand, development strategies in the last decades in El Salvador have had, in most cases, negative consequences on the main environmental problems; only in a few cases have they had favourable consequences.

This paper analyses the above mentioned relationships. The effects of current economic policies are examined, such as interest rates, credit, salaries, and prices. The analysis is divided into three

periods: 1) 1960 to 1979, the import substitution period; 2) 1980 to 1989, the stagnation period, and; 3) 1990 on, the structural adjustment period.

## Stand 3

### Understanding population-development-environment interactions in Mauritius (the PDE-Model)

Wolfgang Lutz

*International Institute for Applied Systems Analysis  
Austria*

This presentation will summarize a recently completed project that has resulted in a forthcoming book (see enclosed list of contents) and a piece of computer software.

The study was an attempt to thoroughly study and better understand the complex population-development-environment interactions in at least a small island with good data availability. The study takes both a qualitative descriptive and a quantitative

computer modeling approach. The model consists of four modules: population, economy, water and land use. The modeling distinguishes between unambiguous direct relationships which are "hard-wired" and disputable associations, and feedbacks that can be defined by the user through means of scenario setting. The model helps to assess the relative importance of population factors, and economic or environmental policies and conditions on long-term sustainable development options.

## Stand 4

### Economic valuation of mangroves EPOMEX / WWF

A.Yáñez-Arancibia and A.L. Lara-Domínguez  
*University of Campeche  
Mexico*



## Stand 5

### Environmental impacts of the structural adjustment program in the agricultural and forest sectors of Costa Rica

Oscar Fallas and María del Mar Cordero  
*Universidad Nacional*  
Costa Rica

Almost all of the countries in Latin America have evolved toward export-oriented economies with a free market, based mostly on the private sector and transnational corporations, as well as on an intensive use of human, natural, and financial resources. It seems that this prevailing tendency, in each country, is a consequence of the hegemony of the financial exporting bloc. The new international division of work, as well as the uncoordinated conditionalities of international financial agencies, are accelerating this process. The end of the Cold War and the emergence of economic, political, and commercial blocs, combine to give some coherence and homogeneity to the new ideological reasoning of the market, to an anti-state interventionist trend, and to a belief in the "equality of opportunity".

Even though the above-mentioned processes have developed unevenly throughout the American Continent, compulsory privatization is visible and wide-spread, as well as non-regulation by the state, new transnational investment offers, social policies focused on macroeconomic management (i.e., those that are compatible with financial liberalization, the market, and payment of the external debt). All these actions are presented as modernization processes, as economic democratization, as "development and equity", as development taking into account nature... or, in other words, as an increase in work productivity and work efficiency, gross national product per person increases, fiscal deficit reduction, salary policies, investment on activities that show comparative advantages to international markets, credit contraction, exchange rate unification, local currency devaluation in order to promote exports, and special arrangements to pay for the external debt with International Financial Agencies and with private banks. It means that a new market value is assigned to natural resources so that this value can be taken into account in production costs (like any other commodity, sustainability is seen as an economic category that is not related to development).

It is also clear that ecosystems and living organisms are not valued, only those resources that are essential for production and the consumer society.

In most Latin American countries where Structural Adjustment Programs (PAE's) are (or were) implemented there has not been a serious consideration of the environmental impacts of these changes; even less attention has been paid to carrying out an exhaustive evaluation of the natural resources base in order to define development goals in the short, medium, and long term. On the contrary, PAE'S have used the surpluses from rural economies to finance industry, agroindustry, and public services, and have continued to significantly affect forests, soils, watersheds, biodiversity, and vital support systems.

Environmental degradation can not be the necessary price of economic growth. Liberalization policies, which are dispersing the States's regulatory and planning powers, are an insufficient and inappropriate means of protecting and preserving the environment. These policies do not take into account the public character of natural resources, ecosystems, and vital support systems. Nor do the PAE's, on environmental matters, consider long-term horizons. Their world is reduced to short term perspectives and to increasing the rate of at which natural resources are used.

This paper intends to present a first advance in the research of the impact of adjustment policies on the forest and agriculture subsectors in Costa Rica. It examines ecosystems that are becoming artificial and are losing some of their biodiversity. This paper analyses the subsequent impact on production, productivity, and identifies the exhaustion and degradation of natural resources.

## Stand 6

### Development of biological techniques for water quality of rivers in Costa Rica -Tropical characteristics

Yamileth Astorga  
*Universidad Nacional*  
Costa Rica

## Stand 7

### Sustainable management of water resources using remote sensing and geographical information systems at the Reventazon Basin

Gerardo Sánchez, Robert C. Harris, Carlos Quesada  
*Universidad de Costa Rica*  
Costa Rica

An integration of digital elevation modelling, satellite remote sensing and geographic information systems of land-cover and land-use in the Reventazon Basin in Costa Rica has been used to identify deforestation trends and possible sources of enhanced sediment erosion. The Reventazon Basin has currently two hydropower complexes in operation for a total installed capacity of 120 MW. Additionally, the basin is a major source of drinking-water for San Jose, Costa Rica's capital city. A good understanding of land-use change/hydrologic relationships is necessary for sustainable development of the region.

Drainage basins boundaries and slope distribution maps were extracted from a Digital Elevation Model (DEM) generated from 1:50,000 topographic maps. A stratified approach for land use

identification using four aggregated land use classes (forest, pasture, urban areas, and agricultural lands) was developed and applied to Landsat Thematic Mapper scenes from 1986 and 1991. The techniques described in this paper quantify the occurrence and spatial distribution of specific land use categories as a function of slope for the basins. The remote sensing and DEM information was later combined through a Geographic Information System (GIS).

The results provide a framework for designing focussed field measurements and policy programs related to soil conservation, and for protecting water resources. In the Reventazon Basin these techniques could help to resolve conflicts between agriculture, hydropower generation, and water quality that are affecting the sustainable management of the basin at several reservoir sites.

## Stand 8

### The Patuxent landscape model for the Patuxent River Watershed

E.B.DeBellevue, T. Maxwell, R. Costanza and M. Jacobsen  
*University of Maryland*  
United States

We are developing the Patuxent Landscape Model (PLM) for the Patuxent River Watershed, Maryland, U.S.A. We are using the Spatial Modeling Workstation (SMW), which combines several software programs and data bases including: the General Ecological Model (GEM), Graphic Information System (GIS) data bases, and the Spatial Modeling Program (SMP), and simulates these on a desktop computing environment consisting of Macintosh computers with transputers installed. The PLM is designed to simulate environmental impacts generated from the changes in land use patterns and practices in the watershed. GEM is a 21 state-variable ecosystem model written in STELLA™ designed for simulating natural and managed ecosystems in a variety of climates. GEM is a process-based model that

simulates flows and storages of water, nitrogen, phosphorus, salt, dissolved oxygen, inorganic soil particles and carbon through the ecosystem. The GIS data base was developed in MAP II™ and data were obtained from four GIS data bases in other formats. GIS files of land use, soils, slopes, weather and elevation serve as inputs to the PLM. The SMP was written in C and links translated replicates of GEM in a spatial cellular grid. The 2,400 km<sup>2</sup> watershed is divided into 5896 0.405 km<sup>2</sup> cells. The PLM calculates exchange flows among adjacent cells and to the estuary and atmosphere. Preliminary hydrologic simulation results that show general agreement with field data are presented. Directions of further work are discussed.

### Distributed hydrologic modeling of a small coastal plain watershed

Lisa Wainger, Tom Maxwell and Robert Costanza  
*University of Maryland*  
United States

A distributed (grid-cell) hydrologic model is being used to assess the relative impacts of land use and well-pumping practices in the Sawmill Creek Watershed in Maryland's coastal plain. The landscape simulation model provides high spatial disaggregation (4900 cells of about 2 acres) and dynamic analysis of watershed conditions. We used a mass-balance process-based approach to model water movement between surface, unsaturated and saturated zones and across the landscape. The dynamic nature of the model allows us to analyze such variables as runoff and evapotranspiration over

short time scales to understand the dynamic water budget. The Maryland DNR provided funding and GTS data of land use, soil type, and river routing and other data types. Supplemental data were gathered from many sources.

The approximately 8.5 mi<sup>2</sup> Sawmill Creek watershed links to the Furnace Creek watershed before the creek empties into Curtis Bay, an estuary near the mouth of the Patapsco River. Sawmill Creek is under scrutiny in part because of decreased, the relationship between pumping and base flow is

clouded by the variability of rainfall, seasonal factors, and land use changes. This modeling effort examines the interactions between these sources of variability.

This project will contribute to a larger effort to

model ecosystem processes at the watershed scale. Results will be used to understand how spatial aggregation influences hydrologic model processes in relation to field processes.

## Impacts of rapid population growth on the global ecological economic system

E.B.DeBellevue  
*University of Maryland*  
United States

The global human population explosion of the Twenty Century is increasing market values of natural resources and the non-market values of externalities. Resource depletion and environmental impacts that reduce production of natural capital and services can now be felt as price increases, that result from supply curves shifting to the left and demand curves shifting to the right. Modern resource depletion in some economic production sectors, especially fisheries and forestry, cause the backward bending of supply curves with resulting prices increases. Prior to the Twentieth Century the population size relative to the global resource base was so small that these shifts were generally minor and localized. Leftward supply curve shifts were prevented by resource explanation via global colonization and the fossil fueled industrial revolution. However, finite global resource limitation is forcing a shift in the emphasis placed on the economic valuation of natural capital and services as they

become relatively more scarce and as people become more abundant. The global socio-economic system is beginning to feel the pinch that occurs when technologically driven increases in resource location, extraction, production, transportation, and substitution can not keep pace with exponential population growth. Much of the mechanics for estimating the potential economic impacts of these depletions have been previously developed in resource economic theory, but have not received widespread application at either micro or macro-economic scales. This paper discusses the extension of Colin Clark's pioneering work in mathematical bioeconomics, to optimal management of renewable resources at a global scale. It also discusses reasons behind both political and theoretical resistance to change emphasis from a human labor and capital dominated economic paradigm, to one that includes analytical emphasis of both natural and human capital and services.

## Stand 9

### Towards a sustainable use of groundwater by means of economic incentives

Doede Wiersma  
*University of Groningen*  
The Netherlands

Groundwater is in the existing economic theory (Moncur and Pollock, 1988; Tietenberg, 1992) treated as an exhaustible resource, which stock has

to be allocated efficiently between generations. This approach is valid when the depletion of groundwater causes no environmental damage to ecosystems.

Such situations exist when the development of nature depends only on the saturated water level of the surface of the soil and not on the groundwater level. In the Netherlands this theoretical approach is not suitable for application, because the extraction of groundwater creates different problems. The depletion of the groundwater stock is not the main problem. Instead, the extraction of groundwater results in big parts of the country to damage of ecosystems which development is very sensible to the groundwater level. An average decrease of the groundwater level, even with 0.20 meters, has led to substantial withering of the vegetation. As a consequence of this development a different theoretical approach is needed for reaching a more sustainable use of groundwater. In the paper the possibilities for such an approach are explored. It consists of two parts. In the first part the water balance and the present allocation and price setting practices of groundwater in the Netherlands are summarized. From this survey it can be concluded

that the existing allocation system has failed in two ways:

- environmental damage costs of extraction of groundwater have not been taken into account;
- The allocation among different users is not efficient.

Alternatives to restore both failures are discussed in the second part of the paper. Firstly, it will be shown that a sustainable use groundwater can be reached by means of regional ceilings on the total amount of extraction. Next, it shows that a second price bid auction seems the most suitable allocation mechanism for regional water markets at which strategic behaviour of the participants is a real possibility. An empirical estimate shows that the costs of the needed reduction of groundwater extraction by means of this mechanism can be 20 percent lower than with the existing system.

## Stand 10

### Secretariat Conference

## Stand 11

### Economics and the environment on the agricultural frontier: needs, knowledge and networks of colonists and *coca* producers

Jan A. J. Karremans

*Centro Agronómico Tropical de Investigación y Enseñanza*  
Costa Rica

The colonists that arrive on the agricultural frontier in the Colombian Amazon basin face a series of difficulties in trying to establish a farming system that provides them and their families with such basic needs as food, water, clothing, medicine and

security. Their agricultural knowledge, well adapted to their regions of origin, shows minimal fit with the new ecological, social and economic circumstances on the frontier. Social networks are soon established and form the basis for survival and growth. The

introduction of coca-leaf production redefines peasant economics and the social relations that make up the newly formed local communities. The cocaine-economy influences strongly the way the environment is managed, and mismanaged in colonists's own terms. At the same time, particular characteristics of the natural resource base limit the

choices available to colonists, whereas their perceived needs, the knowledge they have gained on the present and previous frontiers, and the networks they have gained on the present and previous, frontiers, and the networks they have been able to establish and maintain, determine their capability to turn nature's resources to their best advantage.

## Stand 12

**I.S.E.E.**  
**International Society of Ecological Economics**

## Stand 13

**N.A.S.A.**  
**National Aeronautics and Space Administration**

## Stand 14

**Landscapes and power lines planning in France**

**Gro Waeraas**  
*Electricité de France*  
France

EdF is a french state owned electricity utility. It has 120.000 employees and distributes electricity to 28 million consumers. It now develops new

approaches to power lines planning in order to protect valuable landscapes, fauna and flora.

There are several approaches to the management of landscapes and power lines within EdF: a technical, an economical and a social (citizen-oriented) approach. In order to facilitate the decision-making process and to conciliate all three of them, a multicriteria analysis is being used.

The technical approach aims at developing qualitative or quantitative criterias used to measure the environmental impact of power lines. The criteria cover esthetical, electric and ecological impact (including electro-magnetic fields and human health).

Traditionally, EdF applies cost-benefit analysis in

power lines planning. In order enlarge this approach and asses the total landscape value (including existence and option values), a contingent valuation study is being undertaken.

The construction of new high voltage power lines leads more often than not to conflicts between ecologists, consumers, politicians and EdF. A study has been made which shows that in addition to esthetical, ecological and health concerns, the citizens claim a participation in the decision-making process.

The economic value and the various technical criterias are integrated in a multicriteria analysis which will be used in future dialogs with the citizens living near the planned power line.

## Stand 15

### The economics of tropical forest land use options: a case study of eastern Amazonian

Michael I. Collins

*International Institute for Environment and Development*  
Brazil

This paper reports preliminary findings from a collaborative research project to evaluate alternative land uses in the eastern Amazon region. The study entails an empirical evaluation of the economic and environmental costs and benefits and distributional consequences of alternative land uses in the State of Pará, Brazil. The land uses considered include agriculture (for annual and perennial crops), cattle

ranching and timber extraction, as well as other potential land uses, such as agroforestry. This study also considers the explicit measurement of non-timber forest products. Environmental costs and benefits associated with these land uses and which are under consideration in this study include the effects of land use changes on the incidence of fire and changes in carbon storage.

## Stand 16

**Revista Forestal Centroamericana  
Centro Agronómico Tropical de Investigación y Enseñanza  
Costa Rica**

## Stand 17

**Revista Vida Silvestre Neotropical**

**Miriam Carranza**  
*Universidad Nacional*  
Costa Rica

**Regional wildlife management program for Mesoamerica and the Caribbean**

**Claudette Mo**  
*Universidad Nacional*  
Costa Rica

The Regional Wildlife Management Program was created in 1987 to train Latin American professionals in the wildlife-biodiversity-natural resource field, to plan, develop and carry out research, outreach, teaching and management projects. It has 3 major components: a) training at the graduate level "in-situ", b) developing model wildlife-biodiversity projects, and c) outreach through regional information and technology transfer, including a documentation center (BIODOC), an international scientific journal (Vida Silvestre Neotropical), and a series of books. We have graduated 31 students to date, and have had students representing 16 countries from the

Americas. The journal Vida Silvestre Neotropical is trilingual and aims at the important group of researchers who work in the Neotropic, including Mexico through South America, including the Caribbean. It publishes in Spanish, Portuguese, and English. The books we are offering presently are "Neotropical Wildlife: Diagnostic and Conservation Strategy", edited by Eduardo Carrillo and Christopher Vaughan, "Ecology of White-tailed deer in Costa Rica and Mexico", edited by Christopher Vaughan and Miguel A. Rodríguez, and "Aquatic Flora of Palo Verde Wetlands", by Daniel Hernández and Jorge Gómez.



## Stand 18

**Macrosystems: a holistic tool to enter in the process of sustainability**

Víctor Montero  
*Universidad Nacional*  
Costa Rica

## Stand 19

**I.I.C.A.**  
**Inter-American Institute for Cooperation on Agriculture**

## Stand 20

**Profits, equity, growth and sustainability: the potential role of  
wildlife enterprises in Namibia**

Barnes, J.  
*World Wide Foundation*  
Namibia

Namibia is endowed with valuable wildlife resources. It already earns some economic benefit from them, mainly through tourism which is one of the fastest growing industries. However, to date the potential has been under-utilized, and residents of communal areas are excluded from sharing in the benefits. Emerging economic data and comparisons with data from Botswana indicate that wildlife utilization does have potential to address economic priorities in Namibia: it could provide significant economic and financial returns in communal areas such as Caprivi. As a complementary activity to

livestock, it could boost farmers' incomes and diversify risk. Wildlife utilization enterprises would simultaneously promote sustainability and biodiversity conservation.

These potential benefits will only be realized if they are first recognized by decision-makers, and if use of the resources is well-planned. The historic lack of environmental economics and land-use planning, the inherited attitudes to conservation and livestock, and the urgent economic needs of newly-independent Namibia make this a challenge.

## **Stand 21**

**E.A.R.T.H.**  
**Escuela Agrícola Regional del Trópico Húmedo**

## **Stand 22**

**U.S.A. Embassy**

## **Stand 23**

**Carlos Conejo**  
*Maestría en Política Económica, Universidad Nacional*  
Costa Rica

## **Stand 24**

**Banco Popular de Desarrollo Comunal**

## **Stand 25**

**Instituto El Milenio**

## Stand 26

### Trade and environment in Asia-Pacific: a regional model of environmental management

Lyuba Zarsky

*Nautilus Institute for Security and Sustainable Development*  
United States

The fifteen member countries of the Asia Pacific Economic Cooperation group (APEC) are pursuing a course of rapid trade liberalization. The region is already highly integrated, with some 65% of total trade occurring within the countries of the region. Economic integration is also evident in high level of intra-regional investment and tourism.

Economic models predict substantial static and dynamic benefits of regional trade integration arising from specialization and spurs to innovation. However, such models do not include environmental costs. Such costs could come from two sources: 1) externalities--the direct degradation to the environment arising from the exclusion of environmental costs in company (and consumer) cost structures; 2) changes in the relative social power of different groups. North American trade liberalization in agriculture, for example, could greatly undermine corn bio-diversity by helping to drive Mexican

peasants off their land. A large tide of US monocultural exports would devastate the highly diverse cropping patterns of Mexican peasants.

This paper has three objectives. First, it aims to develop a theoretical model of regional trade integration which incorporates both environmental externalities and socio-environmental impacts. It also analyzes the net benefits of regional cooperation in managing trade-environment links, including reduced transactions costs and reduced incentives to compete by keeping environmental standards low. Second, it surveys some of the key trade-environment issues in the Asia-Pacific and proposes a policy agenda for APEC which includes: convergence of domestic environmental policy; enhanced monitoring and enforcement mechanisms; technology transfer and investment agreements, and complementary eco-labelling schemes to promote "green" exports.

## Stand 27

### Sustainable development in an ecological age: the role of economics in the resolution of the environmental crisis

Barry Allen  
*Rollins College*  
United States

Increasingly, the way the world organizes its economic activities is being seen as a key (if not THE key) variable in the environmental crisis. This

renewed interest in the impact of the economy on the rest of the social and natural world is causing a reexamination of both the mainstream neo-classical

economic model of itself and also the way the model interacts with ecological and socio-cultural variables.

The most often discusses critiques of current practices can be catalogued in one of three approaches.

1. The first holds that the key to arresting environmental degradation is increased economic growth (as traditionally defined as growth in Gross Domestic Product). This view holds that the mainstream model is both sound and appropriate (and that environmental problems have been grossly exaggerated).

2. The second critique also sees the traditional and mainstream model as providing an appropriate framework for organizing the economy, but identifies

a number of problems in the model's approach to environmental variables. These problems are seen to be quite manageable, given certain "reforms" and revisions at the margins of the model.

3. Finally, a more radical critique sees the model itself as the cause of the environmental crisis. This critique holds that only a more holistic approach to human development will enable the world to prevent further environmental decline and cultural destruction.

This presentation will examine each of these critiques of the current economy/environment relationship, and explore how elements of each can be integrated to provide a framework for sustainable development.

## Stand 28

### Forest ecosystems in the Eastern Amazon: the case of bauxite mining in Porto Trombetas (Pará Brazil)

Joao Ferraz  
*National Institute for Amazon Research*

Joao Carlos Henriques  
*Rio do Norte Mining Corporation*

Peter H. May  
*Federal Rural University of Rio de Janeiro*

Alexandre Castillo  
*Rio do Norte Mining Corporation  
Brazil*

Environmental impacts of bauxite mining are of lesser geographical significance for tropical forestlands when compared with other land uses, such as pastures, in the Amazon basin. However, the knowledge obtained from rehabilitating mined lands in the region is of great significance for the recuperation of other degraded tropical forestlands.

The paper describes the socio-economics significance of bauxite mining to the region and its long-term perspectives. Secondly, it presents the technology and costs and evaluates the sustainability of ecological rehabilitation activities undertaken in the case of bauxite mining at Porto Trombetas. At this site over one-hundred native forest species were used to reforest sterile mining spoil, with excellent silvicultural results.

The benefits of ecological rehabilitation for maintenance of biodiversity, provision of indirect services and habitat are described and quantified to

the extent possible. The paper concludes with guidelines for further technology testing and transfer to other settings.

## Stand 29

### Model development of mangrove and shrimp pond ecosystems as input functions to economic analysis of sustainable coastal zone management

R. Robert Twilley

*University of Southwestern Louisiana*

Alejandro Bodero

*Proyecto de Manejo de Recursos Costeras*

Robert Gottfried

*The University of the South*

Several factors have been associated with fluctuating availability of post larvae shrimp in the estuaries along the coast of Ecuador including decreased recruitment (following an El Niño event), loss of mangrove habitat, decline in water quality (increased occurrence of red tide, pesticides, and heavy metals), and to indiscriminate over fishing of available wild stocks. By 1991, the total construction of shrimp ponds was 150,000 ha, and most of this development occurred in the intertidal zone. There was immediate concern that the unregulated growth of this industry had destroyed the ecological processes of coastal ecosystems, which threatened the sustainability of shrimp farming in Ecuador. Most of the concern was centered around the loss of ecological functions of mangroves, which is attributed to maintaining habitat and water quality of coastal ecosystems. Changes in the ecological function of the coastal zone is a combination of both the loss of mangroves, and the

replacement of these forested wetlands with shrimp pond ecosystems that have different ecological processes. This presentation will describe the development and simulation of ecological models of mangrove and shrimp pond ecosystems. These models will demonstrate the different inputs and outputs of water, sediment, nutrients, and organic matter under different management scenarios. The focus of the models is to develop sensitivity analyses of the response of these ecosystems to changes in environmental quality (e.g. suspended sediment, dissolved oxygen, nutrients). The output of these ecological models will be linked to dynamic models of economic-ecologic interactions described in the abstract by Gottfried et al. The objective of our collaborative research effort is to develop methodologies to investigate the multiproduct function of ecosystems at the watershed scale to determine opportunity costs of different management schemes for shrimp farming in Ecuador.

## **Towards an ecological-economic dynamic simulation model of shrimp pond and mangrove interactions in Ecuador**

**Robert Gottfried**  
*The University of South*

**Mireya Pozo**  
*Proyecto de Manejo de Recursos Costeros*

**Robert Twilley**  
*University of Southwestern Louisiana*

Several of the goods and services produced by mangroves serve as inputs to shrimp ponds, whose outputs, in turn, may serve as inputs to mangroves. For instance, sediment retention and nutrient uptake by mangroves affect the water quality, costs and profits of shrimp ponds. The latter discharge more salient and nutrient-laden water to the estuary, thereby affecting mangroves. The abstract by Twilley et al., describes these input-output relationships between mangroves and shrimp ponds. This paper explores the potential impact of changes in water quality on shrimp pond profits. A dynamic simulation model examines the sensitivity of shrimp growth and mortality, and hence, production costs and revenue, to varying levels of water quality. It

also examines the sensitivity of the system to changes in economic variables such as the prices of shrimp and oil. The model then explores the implications of various pond management strategies: e.g., pond operators may respond to differing water quality by changing feeding rates and pumping rates. These strategies have implications for profits and for outputs of the pond to identify areas of ecological knowledge necessary for establishing the impact of water quality on pond profitability and, therefore, the sustainability of the shrimp pond industry. The paper ends with a discussion of the current status of the model, the work remaining to complete it, and its future use to derive total, average, and marginal values of mangroves.

## **Stand 30**

**Comunidad Bahai**

## Stand 31

### Discounting global warming

Thomas Sterner  
*University of Gothenburg*

Christian Azar  
*Chalmers University of Technology*  
Sweden

This paper starts by reviewing some of the economics of global warming and then concentrates on the consequences for total cost estimates of two particular factors: firstly the way in which future costs are discounted and secondly the way in which costs are treated which affect social groups with widely differing income levels.

Both of these factors are essentially linked with the (often implicit) assumptions made concerning the underlying utility and welfare functions. It is common to aggregate welfare gains and losses across generations and countries as if the utility of money were constant but it is not. A cost of \$1 (induced for instance by global warming) is far more serious a loss of welfare for a poor person in Bangladesh than for a wealthy Swede. Similarly the costs for future generations depend on the assumptions made concerning their economic standard.

One of the main determinants of the discount rate is the rate of economic growth. If growth rates

decline in the future then the discount rate should not be constant but also decline over time. In fact we would then need not a single discount rate but rather a variable discount schedule. This would imply higher present values for the distant future. The paper analyses how discount rates would vary with different assumptions about the patterns of growth and the pure rate of time preference.

The final part investigates the effects on cost estimates of different assumption about how to value the distributional effects of the incidence of global warming. Even if we assume that the costs are spread evenly over the globe the welfare effects would not be evenly spread since, as mentioned above, the welfare weight of an income loss depends on a person's income level. This section will discuss the effects on total cost estimates of making certain (intuitively appealing) explicit assumptions about the global welfare function.

### Gasoline demand and emissions of CO<sub>2</sub> and NO<sub>x</sub> in Africa

Mohammed Delhaj  
*University of Gothenburg*  
Sweden

In this paper we study the development of gasoline demand for some african countries. We attempt to identify some of the factors that have determined the level and the pattern of gasoline demand during the 1960s, 1970s and 1980s.

Demand for gasoline is derived from the demand for transportation itself and therefore has two components of adjustment: vehicle utilization and the composition of the vehicle stock. Given that cars are a long lived asset, demand adjustment necessarily

occurs over a number of years. This adjustment process can be modelled in a number of ways. Since our main interest here is in long-run effects we use the dynamic models used to capture the temporal aspect of the adaptation process. The results show a strong link between income and gasoline demand. Conversely, the price elasticity of gasoline is lower. Oil demand behavior is more complex. Oil products can be rationed, or domestic energy production can affect gasoline demand.

Emissions control should be given the highest priority in any air pollution abatement program. Emission control should be completed by actions to improve traffic flow, to reduce traffic volumes and in the long run change urban and regional travel patterns in Africa where the growth rate of population and thereby the growth of urbanization are very high.

## Stand 32

### **Environmental auditorship: a technical premise to correct the eco-economic relationship of the Central American industry with its environment**

Ella Santana Bendix

*Asociación Costarricense para el Desarrollo de la Calidad*  
Costa Rica

It is very important for the Centralamerican industry to include into its quality policies and managerial measure policies, the environmental component in order to correct the production-environment unity relationship. It happens specially in Costa Rica, where a model of wide protected-areas is being promoted, and doesn't count on an effective territorial development that confines the industrial zones.

The industrial sector in Centralamerica hasn't valued yet the impact that is generated by processes and other practices by private enterprise in its

environment; it is unknown how the environment is quantitatively affected and which the carrying capacity is of this environment. That is why it is urgent a constant revision of energy and matter inputs and outputs between each industry, as a subsystem, and its surroundings.

This work presents an environmental auditorship model that applies to the local industry, which allows to detect the responsible points that are responsible for pollution, and consequently to find solutions in order to minimize the amount of pollutants that are generated.



## Stand 33

### Finding a policy to ensure that optimal harvesting is economically stable

Fraser Smith and Jonathan Roughgarden  
*Stanford University*  
United States

Using the logistic equation for population growth with an added harvesting component, we derive the economically optimal harvesting rate and the stock size (population size) associated with it. Unfortunately, this stock size is unstable. Simulated populations converge to stable equilibria quite different from the economically, optimal stock size.

We show analytically that the economically stable harvesting strategy is one where price per organism harvested *increases* with stock size, with a tax on this price increasing as stock size decreases. Under this regime, the stock can be maintained at stable sizes and harvested at the economic optimum.

## Stand 34

### Commercial wild species rearing: an alternative view of regulation and competing groups

Dean Carlson and Frederick Tank  
*The University of Toledo*  
United States

This paper takes a view that is contrary to that put forth in a recent paper written by Ronald Johnson and published in the *Journal of Environmental Economics and Management*. In this article the author suggests that traditional regulatory devices such as output quotas and restrictions on capital inputs provide limited to no protection to commercial enterprises engaged in captive breeding of nongame species. We show that while captive breeding will be more profitable under traditional regulatory devices, wild species production can prosper even without regulations. The paper uses a simple model taken from mathematical ecology with an example utilizing

rare parrots found in Central and South America. Our commensal model shows that in a dynamic ecological setting that the commercial captive rearing of wild animals is not only consistent with the preservation of existing species stocks but also necessary. This result is obtained rather simply by introducing habitat shrinkage over time. Despite the some negative (but quantitatively small) external effects ... accelerated deforestation and the decline in the value of the habitat... the commercial breeding alternative will be the direct result of rent dissipation in the open-access setting.

## Using GAMS to solve economic-growth models with time delay

Dean A. Carlson and Lorena Salazar  
*The University of Toledo*  
United States

The role of time delays in continuous time economic growth models has a long history dating back at least to the papers of Kalecki in the mid-thirties. Unfortunately their role in analyzing optimal economic growth models has been limited due to the difficulty in solving the Pontryagin Maximum principle. When considering the responsible economic exploitation of an ecosystem, it becomes more important to consider the effect of time delays as they are naturally encountered in population models. In this talk we address the solution of the

optimal economic growth problem with time delays attacking the problem directly by approximating the model using truncated Fourier series expansions. In this way we are able to convert the problem into one which is amenable to commercial optimization software packages. The package we use is GAMS (General Algebraic Modeling System) a popular general purpose package. We demonstrate the method we propose by considering a classical optimal harvesting problem in which the species growth is determined by a delayed logistic equation.

## Stand 35

**Evergreen Global Resources, Inc. has the solution to the world's number one environmental issue -Municipal solid waste-**

Richard Bell  
United States

Evergreen Global Resources, Inc. has developed a Resource Recovery System that provides a way of managing large volumes of Municipal Solid Waste and of preserving the resource value of the entire waste stream. Some of the constituents may be recovered and sold as recycled material while the balance of the waste stream can be used to make finished salable products or the entire waste stream can be made into finished salable products if there is no market for recycled products.

The EGR Resource Recovery System manages and treats 100% of the waste stream; thus eliminating the need to dispose of any portion of the waste stream to landfills as is done today.

Each step in EGR's Resource Recovery System utilizes conventional apparatus and equipment now in the present day marketplace in ways that are unique to the process.

## Stand 36

Rayen Quiroga Martínez  
*Instituto de Ecología Política*  
Chile

## Stand 37

### Conversion of degraded tropical farms into viable forested systems

Andrew Peloso and Linn Camperler  
*Cornell University/University of California*  
United States

Large portions of previously forested land in the tropics suffer economic depreciation through erosional loss of topsoil because they are cleared and applied to inappropriate forms of agriculture, such as pasture for livestock. Soils are often initially acid and infertile, and incapable of sustaining productivity for more than a few years or decades. Erosion exacerbates infertility and ultimately may lead to farm abandonment. This process has already occurred in the Amazon, and its early signs are now seen in Costa Rica.

We have begun experiments on a degraded farm in southern Costa Rica to test hypotheses about the use of native species of timber trees and nitrogen-fixing plants to restore soil fertility and income to farms of 8 ha or larger. Although the present price of lumber in Costa Rica is high, the future market of tropical hardwoods is uncertain, and the time to first harvest is not economically viable for small land holders. Therefore, we are proposing and testing an

economic cost-benefit model involving timber trees, leguminous cover crops, and beans on a rotational basis that will allow the farmer to continue to raise some livestock. The plan is predicted to decrease soil erosion, increase soil fertility and production sustainability, and yield income in the first harvest is not economically viable for small land holders. Therefore, we are proposing and testing an economic cost-benefit model involving timber trees, leguminous cover crops, and beans on a rotational basis that will allow the farmer to continue to raise some livestock. The plan is predicted to decrease soil erosion, increase soil fertility and production sustainability, and yield income in the first years from a combination of reforestation incentives and farm productivity.

The unique aspects of the model and its test are the use of native trees and cover crops adapted to the soils and climate, and the application of the test to a farm already in an advanced stage of ecological and economic degradation.

## Stand 38

### Environmental impact of pesticide use in a tropical aquatic ecosystem (Case study in a banana plantation in Costa Rica)

L. E. Castillo, C. Ruepert and E. Solis  
*Universidad Nacional*  
Costa Rica

It is estimated that more than a third of the pesticide volume imported in Costa Rica is used on banana plantations. Fungicides are applied up to 40 times a year by airplane, while highly toxic nematicides are applied up to 4 times a year directly to the ground. The intensive use of pesticides, together with the type of application, the toxicity of some of the compounds used, the drainage system of the banana plantations and the heavy rainfall, make the water bodies in the area vulnerable. Although environmental problems like fish and crayfish mortalities have occurred frequently, studies on the fate and environmental impact of pesticides on the aquatic ecosystem of agricultural areas of Costa Rica have not been carried out previously. In general such studies are scarce in tropical regions.

The study presented here assesses the impact of pesticide use on a tropical aquatic ecosystem using an integrated approach that takes into account environmental levels of pesticides and effects on aquatic organisms. The biological effects are being assessed by acute and chronic toxicity studies, and the determination of the biodiversity of macrobenthic organisms.

The study sites are located in the basin of the Suerte River in one of the main banana growing areas of the country. This river drains into the canals of

the National Park of Tortuguero, a protected area of great biological richness and refuge for several endangered species. The sampling sites selected include main drainage ditches in the banana plantation, streams and several points in the river down to the canals of Tortuguero.

In each sampling site, samples of water, sediments and aquatic organisms are collected bimonthly for residue analysis. Water is also collected in the same points for acute and chronic toxicity testing. *Macrobrachium rosenberii* and *Thamnocephalus platyurus* are used as test organisms in the acute studies. Genotoxicity is used as an endpoint for the chronic studies. Artificial and natural substrates are used to study the biodiversity of macrobenthic organisms.

Residues have been found in the surface water of the drainage channels. The most frequently found compounds were the fungicides thiabendazole and propiconazole and the insecticides chlorpirifos and terbufos.

The approach used in this study will be further evaluated in order to develop a model for the assessment of the environmental impact of pesticides adapted to tropical aquatic ecosystems.

## Stand 39

### From production to sustainability -recovering householding principles of economics

Philip Powell  
*Vanderblit University*  
United States

The recent focus on sustainability as guiding principle for economic activity has generated many (often conflicting) definitions of sustainable development. Yet while the terminology may be new, the discussion is not. It is the basic discussion of the biases of economic measurements and evaluation which the following paper summarizes as productive vs. sustaining functions. The fascination of economics with productive functions has led to the detrimental neglect of sustaining parallels the neglect of the "informal" social (and ecological)

contributions of female householdership which proves equally as detrimental as the neglect of ecological sustainability. In examining qualities which would redefine economic principles the focus will be on the recovering knowing (as holistic knowledge), nurture and concretion as householding principles which provide for a sustaining orientation. Without deterring from the importance of gender (especially in economics) this discussion is also to be viewed in a broader context of "mind-sets" determining economic valuation and valuation criteria.

## Stand 1

### Environmental impacts of packaging materials in U.S. and México

Frank Ackerman

*Tellus Institute for Resource and Environmental Strategies*  
United States

Consumer packaging account for a large fraction of the solid waste stream in industrial countries, and is frequently targeted in waste reduction and recycling efforts. To guide the formation of public policy toward packaging, a number of questions should be addressed: What are the lifecycle environmental impacts of packaging? How much difference does recycling make? Are there some environmentally preferred packages, or is it all similar in impact?

Two major studies have addressed these questions, one in the U.S. and one in Mexico. The U.S. study, sponsored by EPA, several state agencies, and industry groups, was performed by Tellus Institute over a three-year period, 1989-92. It examined air and water emissions from production and disposal of 15 different packaging materials, including both virgin and recycled materials where data permitted. It also analyzed marginal disposal costs per ton of each material in New Jersey, a high disposal cost state. Emissions were ranked by human health hazard, and given monetary values based on U.S. pollution control costs.

The resulting evaluation showed that one material, polyvinyl chloride (PVC), is substantially more hazardous than other packaging, due to vinyl chloride and other emissions during production. Most other packaging materials had broadly similar impacts. Differences in package weight were often more important than choice of material. PVC aside, the lightestweight package is usually the best (minimizes environmental damage) on a lifecycle basis. This poses an important dilemma for policy: When is a heavier but recyclable package preferable to a lighter but nonrecyclable one? Unless recycling rates approach 100%, the heavier, recyclable option may cause more environmental harm.

The second study, sponsored by Mexican industry groups, is being performed in the first half of 1994. Tellus and two other research groups will examine very similar questions in the context of the Mexican economy, looking at production and disposal of 19 different Mexican packages. Comparative analysis of the U.S. and Mexican study results will be available for the first time at the ISEE conference, and will allow discussion of international differences or similarities in packaging impacts and policy.

## Stand 2

### Coffee production technology and energy efficiency in Costa Rica: What is the real cost?

Bernardo Aguilar

*The School for Field Studies*  
Costa Rica

Costa Rica, as many less developed countries, depends on a primary product export based model of development. Coffee has historically been one of

these exports and plays a significant role in shaping the social and political landscape of the country.

These factors and the exhaustion of the agricultural frontier have contributed to the development of one of the best production technologies in the world. This results in very high yields per unit area and one of the best quality products found in the market. Yet, how much of this improvement is at the expense of the degradation of the natural resource base, remains unknown. This paper addresses this issue using energy productivity as an indicator.

The geographic framework is the canton of Atenas, province of Alajuela, representative of technological improvement in coffee production. The processing plants in this region get some of the highest producer prices for all Costa Rica, even if located at a lower altitude than the optimal for production (700 meters).

Through an adaptation of a biophysical model

(Cleveland, 1994) we determine the interrelation between energy productivity in coffee production, energy use per hectare planted, farm size, energy prices and rain in the previous year. The model disaggregates energy use in three monotonic series to differentiate the response of energy productivity to maximum energy use, energy cuts and recoveries in consumption levels through time. The final coefficient estimates are derived through a ridge regression procedure due to the high level of multicollinearity found in the original model.

Results suggest a decrease in energy productivity for the period studied (1980-92) not compensated by technological improvements. The optimality of the production technology is questionable by this finding. Higher yields and better quality of coffee seem achieved through increases in energy consumption and at the expense of the natural resource base.

### **An economic valuation of Carara Biological Reserve: potential tourism value as an incentive for improved conservations of marginal protected areas in Costa Rica**

Kate Besleme and Bernardo Aguilar  
*St. Olaf College*  
United States and Costa Rica

Costa Rica is known for its system of protected areas. Yet, not all protection regimes in force are efficiently accomplishing their conservation objectives. There is a lack of resources to manage these areas adequately. Most funding sources and policy makers give priority to units that have large areas for conservation and/or recreational attractions. Thus the conservation of unique ecosystems, such as the recently created Central Pacific Conservation Area and the satellite areas in the West Central Valley of Costa Rica, is not prioritized. The inappropriate management of these areas jeopardizes the last remaining patches of dry transition to humid and humid transition to premontane forest in the country. Additionally, the region is where most of the country's population lives. This can imply that the costs of more effective conservation practices would be higher than in other areas. Therefore a careful assessment of the total economic benefits

that these areas bring to Costa Rica is needed (i.e., use value + option value + existence value).

Being this an area of high tourist visitation, the travel cost method is appropriate to estimate indirect values of conservation. This study measures the potential value of domestic ecotourism for a main conservation unit of this area, The Carara Biological Reserve. The model used to estimate visitation rate introduces indicators of education and income as determinants of demand. These factors seem necessary to find the potential value of these areas from an ecological economic perspective. By observing travel behavior, this study revealed that Costa Ricans are willing to pay \$31 more than they pay per visit to this site, resulting in an annual potential domestic.

## Stand 3

### **Economic instruments for soil conservation in the Republic of Argentina**

Daniel Tomasini, Cristina Alzogaray  
*Dirección de Conservación de Suelos*  
Argentina

Argentina contains a wide variety of soils which support the development of diversified agricultural and cattle ranching activity. In an area of almost 278 million hectares, agricultural and cattle ranching activity covers 200 million hectares, or 72% of the whole area.

Different soil management techniques have resulted in different types of soil degradation. Notably, these include water and wind erosion, as well as physical and chemical degradation, and an increased risk of flooding. The magnitudes of these are: water erosion 25,000,000 hectares, wind erosion 25,000,000 hectares, physical degradation 23,000,000 hectares, chemical degradation 500,000 hectares, and flooding over 20,000,000 hectares.

As a result, National Law 22.428 to promote soil conservation was created in 1982, in order to prevent and control land degradation. All the provinces support this law.

Among the economic benefits given by law 22.428 are non-reimbursable aids, promotion credits, and special incentive measures. Farmers (the main beneficiaries of this law) must join the Conservation Councils in order to develop their practices and get

financial support. The use of this economic instrument for 7 years (1982-1989) has resulted in the incorporation of 2,800,000 hectares under conservation management and another 2,500,000 hectares incorporated as protected areas.

Argentina spends almost 14,000,000 US\$ on this program, which is 40-50% of the whole amount invested in conservation.

Since 1991, the national responsibility for soil conservation falls on the Natural Resources and Human Environment Secretary, there, through the Soil Conservation Directorship, actions are taken to develop the most favourable institutional instruments, legal and economic, for a rational use of resources.

The first integrated soil conservation activity came out of joint Republic-Province efforts, "de Entre Ríos", resulting in a Provincial Plan for soil conservation. The Plan led to the creation of a Soils and Water Conservation Provincial Service, the promotion of a reduction of provincial taxes (Law 8518/89), and the use of national promotion credits in order to finance public works and soil conservation practices (Law 22.428).

## Stand 4

### **Gas emissions and their influence in air pollution**

Rosario Alfaro  
*Universidad Nacional*  
Costa Rica

The National University and ProEco has been developing a study on air monitoring in San Jose,

Costa Rica. The first results indicated that the increase in the importation of used cars went from



7.4% in 1991 to 19.57% and 20.50% in 1992 and 1993 respectively.

Analyzing this tendency, it is estimated that the level of contaminants from vehicle emissions might move from the current 85.673 metric tons to 99.291 metric tons in 1995 or an increase of 15.89%. The investigation detected that the level of particles in suspension varied from 80.0 ug/m<sup>3</sup> (micrograms per cubic meter) to 245 ug/m<sup>3</sup> as individual values at different stations for a sampling period of 8 hours. The limit recommended by WHO is 80.0 ug/m<sup>3</sup> of continuous annual exposure and 240.0 ug/m<sup>3</sup> for 24 hours. Concerning Lead: peak values of 0.81 ug/m<sup>3</sup>

to 1.04 ug/m<sup>3</sup> were found. These values are for an 8 hours sampling only. The WHO standard establishes 1.5 ug/m<sup>3</sup>. For nitrogen oxide (NO<sub>2</sub>): values do not exceed the limit of 100 ug/m<sup>3</sup>, but the measurements go from 28 to 96.9 ug/m<sup>3</sup>. For carbon Dioxide (CO<sub>2</sub>): registered values are lower than the limits but sulfur dioxide approximates its limits at an annual 90 ug/m<sup>3</sup>. For carbon monoxide (CO) measurements, the standard of 15mg/m<sup>3</sup> (or 9 ppm) was used for 8 hours and values detected were lower than the limit. The study revealed that the sampling zones are critical because traffic is heavy, pollution is greater and pedestrian density is higher.

## Stand 5

### Solar cookers - cheap technology with higher ecological benefits

Shyam S. Nandwani  
*Universidad Nacional*  
Costa Rica

After food is cultivated and produced it still often cannot be consumed unless it is properly cooked. Fuelwood is the major energy source in developing countries, and cooking commonly accounts for 90% or more of all energy consumption in those countries. According to U.N. Food and Agricultural Organization some 2,400 million people are expected to face acute fuelwood shortages by the end of the century causing serious nutritional and health consequences.

The development of cooking methods which utilize alternate energy sources, in special solar cookers, can reduce the new burdens of cooking food and decrease deforestation caused by the overcutting of trees for fuelwood.

According to Solar Cookers International- a non profit organization with the mission to promote the use of solar cookers to benefit people and environmental worldwide, by the year 2000 through various research, promotion activities, 2400 million

people will be aware of Solar Cookers and at least 1% of them (24 million or around 5 million families) will be using solar cookers. This will be saving 3.2 million tons of firewood per year and will reduce the emission of 6.7 million of tons of Carbon Dioxide per year, equivalent to saving of US\$670- 1500 million, required for cleaning this carbon dioxide by alternate means. Although solar cookers/ovens can be made for \$10 -\$1,000, however a family size cooker with reasonable durability and efficiency can be made for US\$50 (only material cost).

Exhibitor who has been working and using Solar Oven/cooker for last fifteen years and an author of a book and a patent on Solar cooker, would like to display photographs of various models designed and studied at Universidad Nacional, his personal model used at his house, some selected models used in different countries, english and spanish literature as well as two real solar cookers (depending on the space available).

## Stand 6

### **The effects of alluvial gold panning on the economy and environment - a case study and policy options from Zimbabwe**

Jeanlinda Navunga  
*Ministry of Environment and Tourism*  
Zimbabwe

Over the past several months, the Resources Development Division of the Ministry of the Environment and Tourism has led a major cooperative study of small scale mining in Zimbabwe. The study has been a joint effort between Divisional professional staff, the Department of Statistics - University of Zimbabwe, a contract statistician, the Department of Natural Resources, the Small Scale Mining Association, and the University of Uppsala in Sweden. Funding has mainly been through the EPCU project of the five-year Canada/Zimbabwe Natural Resources Management Programme.

Small scale mining, especially illegal gold panning in river beds has emerged as a serious environmental problem throughout Zimbabwe. Gold panning activity has increased dramatically in the past few years in what many people feel is a response to the severe drought and tough economic climate in the country. Many panners have few alternative means of earning income to meet the basic needs of their families and themselves.

A serious policy issue has developed. Environmental groups are calling for stricter enforcement of existing laws covering illegal gold panning while other groups have supported the miners' right to earn a living off the land.

One reason for this policy failure is the lack of sound data on the small-scale mining sector. To help develop more effective policy and legislation governing gold panning, better data are required on both the socioeconomic characteristics and benefits of the gold panning sector, and the major costs of resulting environmental impacts.

Nearly 300 gold panners were interviewed using a controlled statistical approach to collect data on social and economic characteristics of the panners and their families. As well, detailed information on gold prices and marketing was gathered. The team also measured deforestation at specific points along the rivers sampled. Rough assessments of siltation from tunnelling and planning and panning activities were also made. The statistical sampling allows inferences about gold panning to be made at both the provincial and in some cases, the national levels. The study compares the costs and benefits of gold panning and present policy recommendations.

The high quality of the data base has permitted a very detailed analysis. Early results confirm some of the conventional wisdom surrounding the economics of gold panning, reasons why panners participate in this activity, and the nature of marketing gold. However, the data also appear to shatter many current myths and policy suggestions.

## Stand 7

### **Sustainable management of water resources using remote sensing and geographical information systems at the Reventazon Basin**

**Gerardo Sánchez, Robert C. Harris, Carlos Quesada**  
*Universidad de Costa Rica*  
Costa Rica

An integration of digital elevation modelling, satellite remote sensing and geographic information systems of land-cover and land-use in the Reventazon Basin in Costa Rica has been used to identify deforestation trends and possible sources of enhanced sediment erosion. The Reventazon Basin has currently two hydropower complexes in operation for a total installed capacity of 120 MW. Additionally, the basin is a major source of drinking-water for San Jose, Costa Rica's capital city. A good understanding of land-use change/hydrologic relationships is necessary for sustainable development of the region.

Drainage basins boundaries and slope distribution maps were extracted from a Digital Elevation Model (DEM) generated from 1:50,000 topographic maps. A stratified approach for land use identification using four aggregated land use classes

(forest, pasture, urban areas, and agricultural lands) was developed and applied to Landsat Thematic Mapper scenes from 1986 and 1991. The techniques described in this paper quantify the occurrence and spatial distribution of specific land use categories as a function of slope for the basins. The remote sensing and DEM information was later combined through a Geographic Information System (GIS).

The results provide a framework for designing focussed field measurements and policy programs related to soil conservation, and for protecting water resources. In the Reventazon Basin these techniques could help to resolve conflicts between agriculture, hydropower generation, and water quality that are affecting the sustainable management of the basin at several reservoir sites.

## Stand 8

### **Economic valuation of mangrove-fishepond interactions in The Philippines**

**Ron Janssen**  
*Institute for Environmental Studies, Free University*  
The Netherlands

Mangrove forests and swamps are rapidly declining in many parts of the world. This decline is linked to the loss of important environmental functions such as tidal wave control, breeding ground

for fish source of fuel wood etc. Mangroves thus represent a substantial economic value based on use and non-use functions. These values are, however, often not fully appreciated by policy makers. The

objective of this project is to improve the understanding of the value mangroves (both general values and location specific values). These values will

be used to support trade-offs between mangroves and alternative types of land use.

## Stand 9

### Economic valuation of mangrove ecosystem: a case study of Cananea

Mónica Grasso and Y. Schaeffer-Novelli  
*University of Sao Paulo*  
Brazil

Despite legal protection, mangroves have been subjected to many types of exploitation that do not maintain their capacity to support estuarine life. In Brazil we are often faced with real estate enterprises such as harbors and industrial zonings, besides the widespread damaging caused by oil spills and solid disposal. The purposes of this project were not only to assess the benefits of one such ecosystem but also to contribute to political decisions.

In order to show the benefits of mangrove preservation, we used various approaches to assign monetary values to resources that lack market price. Thus, it was chosen an area of preserved mangroves in Cananea with an approximated area of 10,000 ha (Sao Paulo, 25° Lat. S., Brazil). Cananea is a city with a population of 7,726, living primarily on subsistence fishing and agricultural activities, with a

rising share of the local economy being due to tourism.

The Travel Cost Demand Model (TC) and the Contingent Valuation Approach (CV) were used to calculate the recreational benefits of that ecosystem.

The first (TC), was applied in a survey with 95 visitors to calculate the total spending value and the opportunity cost of their time. To calculate the willingness-to-pay (CV) of the visitors, about 161 people were surveyed. The results showed a strong relation between the rate of visitation and the availability of recreational fishing. Beyond these approaches based on the neoclassical theory, we calculated the relation between mangroves areas and fishery productivity.

## Stand 10

### Secretariat Conference

## Stand 11

### Agricultural sustainability indicators for Latinamerican and Caribbean countries

Manuel J. Baldares  
*Universidad de Costa Rica*  
Costa Rica

1. Identification of basic problems for sustainability.

been reached by any one country at any one moment.

a. Natural resources:

1. Forest resource management
2. Soil resource management
3. Water resource management
4. Biodiversity conservation

3. Proposed list of indicators

For each one of the ten problems mentioned in point 1, some indicators are proposed which try to measure the magnitude of these problems, in accordance with the parameters defined in point 2. The indicators are used only if they arise from statistics published periodically for all the countries in the region (or for most of them) and if they come from reliable sources. The result is a proposed list of 35 indicators.

b. Social and economic:

5. Demographic pressure
6. Income inequalities
7. Land tenure
8. External debt
9. Exchange terms deterioration
10. Poverty and a deteriorating standard of living

4. Application to Costa Rica

The 35 proposed indicators are calculated for Costa Rica during the 1960-1992 period. This exercise demonstrates the benefits of this method and its ability to quantify the level of sustainability in a country from the Latin America and Caribbean region.

2. Measurement of Sustainability using four parameters.

Four parameters are established (productivity, equity, elasticity, and stability), through which it is possible to quantify the sustainability level that has

## Stand 12

**I.S.E.E.**  
**International Society of Ecological Economics**

## Stand 13

### **N.A.S.A. National Aeronautics and Space Administration**

## Stand 14

### **Prerequisites for sustainable communities**

**Richard L. Meir**  
*University of California*  
United States

Technologies and strategies have been sought that are suitable for ecodevelopment over the long run. Those that were categorized as "resource-conserving" now have to fit into the concept of sustainable documented. Most are hybrids of traditional methods with ultra-modern digitalized approaches that prevent errors and waste.

Most present proposals for infrastructure and social learning require heavy investments in resources, savings and human attention without moving the communities any closer to sustainability. They are often, also, ecologically imbalanced. I have distilled a number of prerequisite conditions to be achieved in order to maintain a steady state at an adequate level of living over the long run. They are the concluding pages of a recently completed manuscript, "Ecological Planning and Design" (1993), and can be used as criteria for assessing the relative merits of the respective ecotechnologies.

The means of assessing approaches to analyzing, improving and stabilizing communities around the world were relatively arbitrary, until an international Congress on Urban and Peri Urban

Ecosystems was called by UNESCO and the Chinese Academy of Science in 1987. A remarkable consensus was achieved there on a systematic, and truly comprehensive overview of cities and settlements among all the recognized schools of urban ecological thinking. Because the proceedings never were published, a brief outline precedes the presentation of prerequisites.

For the purposes of teaching, the basic models have been split into separate diagrams. The community itself was visualized as something living and developing, like a bud, which was enclosed within a semi-permeable membrane that selectively admitted inputs necessary to life and rejected most of those that were known to be injurious. This Boundary also has channels for export, elimination of wastes and breathing to keep it in rough equilibrium with the environment. The picture cannot be transmitted by e-mail, so the readers will have to use their imagination.

Input-output model: the bounded community has categories of resource.

## Stand 15

### Sustainable development of natural resources in the bufferzone of Tortuguero National Park, Costa Rica

Jorge Korning  
*Fundación Neotrópica*  
Costa Rica

The Tortuguero region in Costa Rica belongs to one of the poorer parts of the country. It is characterized by little stability of the people mainly caused by lack of land tenure and the presence of big banana companies, which has bought a lot of land for plantations. The tendency is a change from independent farmers to salary dependent workers (IUCN 1992). Despite of this situation many locals has expressed their interest in participating in projects for sustainable development. The objective of the programe is to promote activities that 1) maintains and increase forest cover and 2) improve the rational use of the natural resources. Through these activities contribute to improve life quality of the people (Nepenthes & Neotrópica 1993).

A basic principle is that the objectives has to be reached based on the interests, and experiences existing in the region. These are then to be developed improved by the technical assistance given by the project. Wood extraction in the Tortuguero region is done by people outside the region leaving little earning by the local forest owners. Local work up of raw materials contributes to secure a more social and ecological sustainable use of the natural resources. Furthermore it leaves the value added by the local level. A main effort of the project is be the means of forest management plans and plans for local industries together with the local people to create integrated production systems that is socially and economically viable and thereby give the forest a value that makes it worth conserve and manage. Another strategy to diminish the pressure on the

forest is to encourage home gardens and silvopastoral systems.

Forest and wildlife is disappearing rapidly outside the protected areas. Therefore to emphasize the forest as a potential source for new ways to get an income, to improve the general interest in preserving the natural environment and to diminish illegal hunting. The project focus on use of local biodiversity. We have established management of Tepezcuintle (Aguti paca) in captivity. And are establishing a nursery with caimans (Caiman crocodilus ssp. fuscus). It is the hope that with better defined land tenure that the animals can be managed in the forest.

To take advantage of the still greater interest, in the world for ecotourism. The local groups interested in developing some kind of tourism related enterprises are given training and technical assistance on three main subjects: promotion of the present facilities in the area, service required by national and foreign tourists, and the ecological impact of tourism and how to minimize it.

Project activities are seeked planned with social, economic and ecological sustainability as requirements. As the social and economic sustainability mostly are reported by the involved people, the ecological sustainability has to be evaluated by the project. Therefore a small-scale monitoring of the ecological impact of the activities is set up.

## Stand 16

**Revista Forestal Centroamericana  
Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)  
Costa Rica**

## Stand 17

**Revista Vida Silvestre Tropical  
Miriam Carranza  
*Universidad Nacional*  
Costa Rica**

**Regional wildlife management program for Mesoamerica and the Caribbean**

**Claudette Mo  
*Universidad Nacional*  
Costa Rica**

The Regional Wildlife Management Program was created in 1987 to train Latin American professionals in the wildlife-biodiversity-natural resource field, to plan, develop and carry out research, outreach, teaching and management projects. It has 3 major components: a) training at the graduate level "in-situ", b) developing model wildlife-biodiversity projects, and c) outreach through regional information and technology transfer, including a documentation center (BIODOC), an international scientific journal (*Vida Silvestre Neotropical*), and a series of books. We have graduated 31 students to date, and have had students representing 16 countries from the

Americas. The journal *Vida Silvestre Neotropical* is trilingual and aims at the important group of researchers who work in the Neotropics, including Mexico through South America, including the Caribbean. It publishes in Spanish, Portuguese, and English. The books we are offering presently are "Neotropical Wildlife: Diagnostic and Conservation Strategy", edited by Eduardo Carrillo and Christopher Vaughan, "Ecology of White-tailed deer in Costa Rica and Mexico", edited by Christopher Vaughan and Miguel A. Rodríguez, and "Aquatic Flora of Palo Verde Wetlands", by Daniel Hernández and Jorge Gómez.

## Stand 18

**Sociobiotic communities towards the pioneer face**

**Víctor Montero  
*Universidad Nacional*  
Costa Rica**



## Stand 19

### I.I.C.A. Inter-American Institute for Cooperation on Agriculture

## Stand 20

### The fishing industry at the community level along the west coast of Southern Africa

H. K. Konstant  
*University of the Witwatersrand*  
South Africa

The fish of the West Coast of South Africa and Namibia is seen as a depleted resource in comparison with the stock it held in the sixties. Stock levels are now calculated to be at about 5% of those original levels. The population in the region has, however, increased at an average annual rate of 2,7% and the unemployment rate has increased, with some fluctuations, at an average annual rate of 1,5%.

Commercial fishing still continues on a seasonal basis using, as about 70% of its capital base, the same capital of 15-20 years ago.

The landing, processing and packaging of the fish takes place at only three points on the 2,300 km coastline. Small scale fishing, despite all its advantages, have received very little attention. In certain instances they have been discouraged in favor of saving the stock for commercial fishing.

My paper would be a study of community development as a result of promoting small scale labor intensive fishing activities.

The purpose would be to permit a more informed decision of the optimum level of small scale local versus large scale commercial fishing activities in the short and medium term bearing in mind the overriding need for sustainability.

My paper will include a detailed analysis of the present situation and the adverse effects of modern commercial fishing on the communities living on the coast.

A cost benefit analysis will be carried out concerning better quality food for the nation, conservation of marine resources, creation of variety of economic activities in conjunction with small scale fishing, decentralization and distribution of income.

## Stand 21

**E.A.R.T.H.  
Escuela Agrícola de la Región del Trópico Húmedo**

## Stand 22

**U.S.A. Embassy**

## Stand 23

**Sustainable agricultural technology on smaller scale farms**

**Jack York**  
*Organization for Tropical Studies*  
Costa Rica

The purpose of the project is to evaluate the potential for the adoption of a fallow enrichment strategy for a sustainable agricultural technology on smaller scale farms within Costa Rica in the context of the availability of on farm resources and current economic policy. The sustainable agricultural technology is frijol tapado that is a cost effective, slash/mulch technique for producing beans, an important subsistence crop, in resource constrained, smaller scale farms on steeply sloped, marginal quality land. The enrichment strategy is alley cropping locally available leguminous trees within the frijol tapado plots to provide the benefits of soil stabilization on steep slopes to prevent erosion and the addition of nitrogen, an essential plant nutrient,

to the soil. Fallow is used to regenerate fertility within the tapado system. Allowing land to remain idle for two to three years, the normal time for tapado fallow, is problematic because of rising land use pressure being driven by increasing economic pressures. Enrichment allows the fallow time to be reduced without diminishing soil fertility. Current policy is promoting the use of tapado as a subsistence production technique for beans because of the decreased support for basic grains production. Beans are now a difficult cash crop to grow in Costa Rica because of the lack of credit, technical assistance, and government purchases at subsidized prices. At the current time no policies exist to promote agroforestry with subsistence crops. The

resources that previously supported basic grains production are now being used to produce agricultural exports and to support the commercial and industrial sector of the economy. The resources were shifted away from domestic grains production

because the same items could be imported at a lower cost than cultivated domestically. The policy implications are reduced domestic production and increased importation from foreign sources.

## Stand 24

**Banco Popular de Desarrollo Comunal**

## Stand 25

**Instituto El Milenio**

## Stand 26

**A guide to promoting sustainable development: putting complex environmental planning concepts into practice at the grass-roots level**

Adam Drucker  
*UNICEF*  
Brazil

The battle to save the Brazilian rainforest must be fought outside of the Amazon as well as within it. It is in the surrounding cerrado (savannah) and transition areas where the new and expanding agricultural frontier must be fixed once and for all. In 1990 Project New Frontiers of Cooperativism set out to support the sustainability of cerrado agro-ecosystems in order to eliminate the need for the continuous encroachment onto fragile rainforest lands

that are unsuited to conventional agriculture by providing a toll that influences the (NGO) institutional planning context for sustainability (in this case agro-pecuary cooperatives).

One component involved the elaboration of a guide using a simple question and answer format appropriate for the treatment of technical environmental planning concepts by non-specialists

and the placing of responsibility for local resource management issues firmly in the hands of the community. This tool aims to ensure sustainable development through the integration of 6 environmental decision-making instruments into the conventional planning process. These instruments, an environmental diagnostic (establishment of area characteristics), production system studies (consideration of alternatives), environmental impact assessment (of each alternative), environmental economics (economic valuation of impacts) and environmental monitoring and auditing provide the basis for a cost-efficient and systematic appraisal of

environmental concerns of the type that can realistically be expected to be applied within the context of the struggle to meet basic needs in a developing country.

This methodology leads to the elaboration of an innovative cooperative sustainable development plan where (through the use of environmental economics) the sum total of individual project environmental impacts would be constrained to being zero or positive at the programme level. This facilitates the capture of development resources from various agencies.

## Stand 27

### Simulation games in education and decision making on ecology (Russian and American experience)

Iori O. Kogan  
Intrest S.A.  
Costa Rica

We are concerned with the methodology of simulation games as well as Russian and American Experiences organizing and running games which contribute to the development of thought processes relating to ecological economics. A simulation game is an intellectual activity (thinking about the situation, the communication and the action) which is carried out collectively through the group's participation in the simulation.

The game is a model through which some aspect of life is imitated; at the same time it is an intellectual system, a natural system, and a self-developing system which is intended for the solution of complex problems.

The objective of the simulation game is *the development of the individual, of the group, and of the institution through problem-solving*. We shall examine two types of simulation games: *business games* and *innovation games*.

Business games are defined as *reproductive games*, or the reproduction of a known model of

existing situations (for example: American games: *STRATEGEM-1, STRATEGEM-2, World Fishing*; Russian games: *The Island, The Coordinating Commission, Near the Lake*).

Innovation games are *productive games*, in which new aspects are sought in a fairly well-known model, or in which a new model is designed during the game. The productive character of the innovation game enables it to be used as a kind of social experiment which offers the following options:

- The participants find solutions collectively rather than depending on outside solutions.
- The game focuses on renewal, on the modification of the existing situation, on the search for unusual, creative solutions, and on the search for innovation.
- Throughout the game innovative process works as a system.
- The game is a reflective type of activity.

- Problems are solved in a short length of time.
- The game can be used as a consultative procedure.

During the game a new level of *collective understanding* is reached, of oneself, of others, of the situation, and of the problem itself. Decision making strategies are formed and the mechanisms for implementing collective solutions are established.

## Stand 28

### Valuation of non-priced amenities provided by the biological resources within the Monteverde Cloud Forest Preserve, Costa Rica

Jaime Echeverría  
*Centro Científico Tropical*  
Costa Rica

To quantify the economic benefits of the Monteverde Cloud Forest Preserve and to test the contingent valuation method in a third world setting, a contingent valuation survey was designed with five experimental treatments. These determined an overall expected value per visitor; determined and compared two ways of eliciting value, single versus annual lump-sum payments; and compared average values of Costa Rican versus non-Costa Rican visitors.

Visitors were willing to pay to prevent the Preserve's conversion to agricultural uses.

Monteverde's values as a preserve appears much higher than any value it might have in agricultural use. Despite lower incomes, Costa Rican visitors valued the Preserve more highly than non-Costa Rican visitors. Visitors may have differentiated only weakly between greatly differing bid amounts. Expected values derived from econometric analysis of the differing experimental treatments suggest that further methodological adaptation of the contingent valuation method may be required when 1) when it is applied in third world settings, and 2) when precision is critical in estimating WTP's.

## Stand 29

### Planning for sustainable agro-ecosystems

Roderic A. Grill  
*Centre for Agricultural and Resource Economics*  
Australia

Agro-ecosystems are characterized, at least in Australia, by private resource ownership. This kind of tenure relationship implies some discretion in goal

setting and choice of management practices. Private resource managers have, within the constraints imposed by government environmental regulations,

some choice with regard to the ultimate sustainability of the resources under their command. Planning for sustainability, in this context, may involve choice between unsustainably high production in the short-run or the maintenance of a more constant and probably conservative resource carrying capacity into the long-run. The resolution of such considerations have, generally, been poorly serviced by traditional, discounting-based analytical methods. The usual outcome when maximum income is placed as the sole objective, is the recommendation for short-term exploitation rather than longer-run conservation. That many resource managers tend to adopt a more conservative and sustainable production system than might be implied by the preceding outcome, suggests that alternative goals are competing with income maximization to guide private decision making in this regard and/or that actual time preferences are not reasonably represented by a constant, positive discount rate. Ecological economics, as a true

systems perspective, facilitates the explicit recognition of ecological-economics tradeoffs. Little guidance, however, is provided for the practical consideration of these choices for planning purposes.

The aim of this paper is to outline an appropriate procedure for the consideration of the ecological-economic dimensions of farm planning. The specific routine of choice is the long-established System Dynamics simulation approach. System Dynamic models can realistically represent those dynamic, feedback-driven interactions between the ecosystem, producer goals and production that are of central interest to resource managers. To demonstrate the capabilities of the approach, a model is developed to represent the sustainability concerns of an Australian case study farm. The ensuing results are contrasted with those from a more conventional discounting approach.

## Stand 30

### Comunidad Bahai

## Stand 31

### The STOPER model for ecosystem management at the regional level: a case study on municipal sewage sludge

Vasseur, L., P. De Coninck, M. Séguin,  
J. St-Germain and C. Anseau  
*Université de Sherbrooke*  
Canada

Strategies for the optimization of ecosystems can be adequately developed and implemented at the regional level. The interactions between the public,

corporate structures and elected officials can lead to consensual decisions that are more easily achievable at the regional level. In this presentation, we would

like to discuss a specific case study being conducted at the regional level. It addresses the issue of how to manage, in an environmentally sound way, the sewage sludge generated by the wastewater treatment plants present in the municipalities of the Eastern Townships/Monteregie area regional ecosystem (Québec, Canada). Our approach is to integrate, in a systemic analysis, information derived from geographic and demographic data, ecology (specifically agriculture and forestry), technology,

economics, health sciences, and socio-political disciplines. Using the example of a municipality of the Eastern Townships/Monteregie ecosystem, an interactive model will ultimately be designed to provide a series of potential scenarios for action by different regulatory bodies and decision makers. The present study case will illustrate the potential of our transdisciplinary approach as well as the limits and constraints encountered in the development of the model.

## Stand 32

### Landscape modeling in the everglades

H. C. Fitz, E. Reyes, R. Costanza, F.H. Sklar  
*University of Maryland*  
United States

A regional landscape simulation model is being developed to predict changes in vegetation community structure, nutrient exports, and water demands in the Everglades as a function of different water management scenarios. Past water management practices are being blamed for the invasion of cattail (*Typha domingensis*) communities in areas that receive agricultural runoff, the decline in bird populations in areas that are hydrologically "altered", and the lack of freshwater in Florida Bay which some say has led to seagrass die-off and large

algal blooms. The Everglades Landscape Model (ELM) is a parallel processing tool to help solve these problems, test hypotheses associated with landscape succession, and evaluate the impacts of global climate change for the extensive coastal communities of the Everglades. Although the ELM is not complete, the structure of a spatial "unit" is generic and applicable to any ecosystem, and the functions of the spatial modeling package (a system that integrates GIS, ecosystem models, data, compilers, and output drivers) are applicable to any workstation.

### Spatial modeling tools for ecosystem health analysis

Thomas Maxwell and Robert Costanza  
*University of Maryland*  
United States

There are many signs that the collective global economic activity is dramatically altering the self-repairing aspects of the global ecosystem. Protecting and preserving our natural life-support systems requires the ability to understand the direct and indirect effects of human activities over long periods of time and over large areas. Spatial system's

modeling is essential if one's modeling goals include developing a relatively realistic descriptions of past behavior and predictions of the impacts of alternative policies on future behavior. Development of these models has been limited in the past by data requirements, conceptual/computational complexity issues, and insufficient computational resources.

These limitations have begun to erode with the increasing availability of remote sensing data, and the development of faster processors and parallel computer systems. Graphical, object-oriented simulation development tools can help alleviate the model complexity limitations if linked with appropriate supercomputing platforms. In this paper we describe the architecture and applications of our user-friendly environment for spatio-temporal model development in a parallel, distributed computational environment.

We have developed a spatial modeling environment, which consists of a combination of hardware and software tools that allow development, implementation and testing of spatial ecosystem models in a convenient desktop environment. In our system the unit model development and testing is

done on a Macintosh computer using the STELLA™ dynamic simulation development package. A simple configuration step allows the user to link data resources and generate spatially or nonspatially articulated models for parallel or serial computers, including the Connection Machine, networks of Sun Workstations, or Transputer networks embedded in a Macintosh. The system automatically generates code for various distributed computing environments and types of parallelism, alleviating the need for scientists to invest time in computer programming. Modular, hierarchical, object-oriented structure promotes sub-model archiving and reuse. A Hypercard interface guides the user through the model development process. We will discuss several spatial ecosystem models developed using this architecture that are currently being utilized as ecosystem diagnostic tools.

### The multiscale experimental ecosystem research center

E. Reyes, R. Costanza, M. Mageau, J. Brawley  
*University of Maryland*  
United States

The Multiscale Experimental Ecosystem Research Center (MEERC) has been established to develop a rigorous and ecologically meaningful definition of the "health" or "vitality" of ecosystems. As an EPA Center for Exploratory Research, MEERC functions as a nucleus for integrating a broad mix of research projects supported by government agencies and private organization concerned with environmental issues of the coastal zone. MEERC upholds a multidisciplinary program of research designed to evaluate the scale dependence of ecosystem responses to pollutant inputs. General principles of ecosystem structure, function and dynamics are tested over a range of spatial, temporal and complexity scales. Ecosystem simulation models are used to investigate responses to pollutant perturbations and to formulate hypotheses that are simultaneously tested using experimental ecosystems. These physical representations of nature range from small-scale laboratory cosms (< 1 m<sup>2</sup>) to large-scale watershed cosms (in km<sup>2</sup>).

As an example of the research carried on in MEERC, a benthic-pelagic (B/P) simulation model for

several size tanks has been developed. This simulation model contains the following state variables: suspended algae; wall algae; benthic algae; suspended bacteria; benthic bacteria; benthic protozoans; microzooplankton and macrozooplankton. The B/P model has two physical forcing functions related to scale as different size tanks are used: light and its extinction with depth, a relationship between surface area to volume and the relative concentrations of suspended and wall algae.

To examine the ecosystem health aspects of these experiments, research efforts have focused on merging the capabilities of STELLA (a simulation language) and a Network Analysis software (developed by R. Ulanowicz at Chesapeake Biological Lab.). Using output from the STELLA model of the ecosystem in the various tanks will test several systems-level hypotheses: 1) indirect sustenance decreases as the scale of the enclosure becomes smaller, or as ecological complexity is exogenously decreased; 2) higher trophic levels will be excluded and otherwise negatively impacted in the smaller containers resulting in shorter food chains with less



efficient trophic transfers; 3) Systems in the smaller containers should contain fewer cycles, and the median trophic lengths of these cycles should also

decrease; 4) system ascendancy and capacity will be larger in the larger containers.

## Stand 33

### Comparative risk analysis: emphasizing sustainability

Kariann E. Sokulsky, Max Oelschlaeger, Holly Stallworth,  
David J. Molina, Elinor Johansen, Daniel Rodeheaver,  
Richard Kiesling and Wendy Gordon  
*Texas Natural Resource Conservation Commission*  
United States

In a world of limited resources, setting priorities is a necessary step in problem-solving. Each problem is, by definition, significant, but not all problems can be solved simultaneously. Perhaps this is no more evident than in addressing environmental problems. The breadth of environmental problems is extensive and intimidating. As a result, in the United States, *comparative risk analysis* was promoted by the United States Environmental Protection Agency in the late 1980s as a mechanism to prioritize management and funding strategies. The EPA has since supported or is supporting several state and local government projects, including one for the State of Texas.

In comparative risk projects, problems are ranked relative to each other according to risks to human health, ecosystems, and usually, "quality-of-

life. Workgroups are organized according to these three areas and each workgroup produces a separate ranking. Eventually, an integrated ranking should be produced. However, in many projects an integrated ranking is not produced because of the problems in comparing, for example, the risks to human health from lead in drinking water to the risks to wetlands because of non-point source pollution.

This paper will provide a critique of comparative risk analysis and identify and evaluate approaches for producing a final integrated ranking of environmental risks to human health, ecosystem health, and quality-of-life. The emphasis will be on using sustainability as a criterion for developing an integrated ranking of environmental problems.

### The basin planning initiative in Texas

Kariann Sokulsky  
*Texas Natural Resource Conservation Commission*  
United States

A regulatory approach to implement a holistic, or integrated, approach to water resource management is currently being developed by the Texas Natural Resource Conservation Commission, in accordance with the 1991 Texas Clean Rivers Act. The

approach has been named the "basin planning initiative" (BPI) and is based upon the U.S. EPA's watershed protection approach for water quality. In the EPA's watershed protection approach, the protection of water quality is based upon integrating

chemical, physical and hydrological parameters in regulations and management strategies. Another important approach is to implement solutions by setting priorities based upon risk assessments to human health, ecosystem health and socioeconomic

welfare. The Texas BPI will reflect this concept, and more. The Texas BPI will address water quality, water quantity, and aquatic habitat protection issues within a regulatory framework. The BPI concept is expected to be released for public comment in the summer of 1994.

## Stand 34

### Environment, production and foreign commerce

Roxana Salazar  
*Fundación AMBIO*  
Costa Rica

Commerce and industry must integrate the environmental subject as one of the priorities of its activities. Economic changes in our countries include little, or none, consideration on the environment and the impacts caused by the industry. For instance, industrial development bears an increase in energy and other resources use; an inappropriate waste disposal; and changes that affect the environment. Moreover, the most polluted environments are in developing countries.

One possible option, originated by the consumer pressure, is when he or she becomes aware of environmental impacts of productive processes, and then he or she quests a friendly participation, where preoccupied groups, because of environmental problems, direct their purchase decision toward products that protect their health and that have caused less environmental impacts.

Thanks to this increasing awareness, the ecological labelling was born. This means that

producers have developed a wide range of options, like: biodegradable, friend of the ozone, ozone free, phosphate free, friend of water product, green products, dolphin free, etc.

There is an international legal framework that facilitates the protection of citizens and environment.

This new framework defines responsibilities for all sectors searching for sustainable development. Human beings must live with their environmental responsibility, that guarantees to live in harmony with nature, and to achieve, at the same time, a better quality of living.

The environmental seal is an alternative, that combines several factors: a responsible and conscious consumer, that orientates its purchase decision; and a responsible producer that decides to reduce the environmental impacts from its production.

## Stand 35

**Evergreen Global Resources, Inc. has the solution to the world's number one environmental issue -Municipal solid waste-**

Richard Bell  
United States

Evergreen Global Resources, Inc. has developed a Resource Recovery System that provides a way of managing large volumes of Municipal Solid Waste and of preserving the resource value of the entire waste stream. Some of the constituents may be recovered and sold as recycled material while the balance of the waste stream can be used to make finished salable products or the entire waste stream can be made into finished salable products if there is no market for recycled products.

The EGR Resource Recovery System manages and treats 100% of the waste stream; thus eliminating the need to dispose of any portion of the waste stream to landfills as is done today.

Each step in EGR's Resource Recovery System utilizes conventional apparatus and equipment now in the present day marketplace in ways that are unique to the process.

## Stand 36

**Social constructs of sustainability**

Tom MacLean  
United States

Prevailing debate on sustainable future has largely neglected social dimensions. While ecological concerns have finally claimed their place, economic imperatives continue to be the argumental mainframe, particularly among higher-level decision makers. We will urge not only full inclusion but near primacy of the social in guiding us toward sustainability.

Both theoretical and pragmatic discussions have come usually to be imbedded in the context of a world order, and most often a world economic order. We have planned as though we could manage the ecological and the social consequences should our understanding of inter-relatedness of these complex systems be flawed or incomplete. Perhaps thinking globally and executing a global plan can brought

within the reach of human endeavor, but we are seriously alarmed over all proposals along this path. It may not be simply a matter of making those decisions within equalitarian fora of consensus or deliberative democracy -or of intelligence- or of physical capacity to set huge ventures in motion -or even of moral integrity, though those concerns remain real and urgent.

The discomfoting reality is beginning to seem that such complexity is well beyond our capacity to handle without making dangerous and tragic oversimplifications, without committing ourselves to courses intractably resistant to correction, without subverting ethical restraint and without violating our cultures' delicate webs of affection, nurturance and partnership with each other and the land. Our better

intuition is that a truly sustainable order will be diffuse and flexible, and on an experimental path toward correcting present deficiencies and injustices. It would be comprised largely of decentralized communities, using consensus to clarify and express their specific preferred social and economic values. The result would be a true "culture of the commons"... something akin to networks of mutual

aid and reciprocity, a limited market with production primarily for immediate use rather than speculation, redistribution rather than accumulation of surplus, extended family and village as the basic units of socialization and production, principles mandating primacy to harmonious relationships with nature and a insistence that political power reside solely within the community.

## Stand 37

### **Agricultural and environmental history in the American Midwest: a record of the human conversation with nature, and an ecological cautionary tale**

Gregory Mclsaac and Bruce Hannon  
*University of Illinois Champaign-Urbana*  
United States

In his essay "Nature as Measure", the writer and farmer Wendell Berry suggests that we should farm as if we were carrying on a conversation with Nature (Berry, 1990). In this conversation, we should ask: What would nature be doing if no one was farming here? What would nature permit us to do here with least harm to our natural and human neighbors? What would nature help us to do here? For Berry, nature apparently agreed with Phillip Morris and said "grow tobacco". Although we may dislike this or other aspects of Berry's conversation with nature, his questions should prompt us to examine our own conversations with nature.

The near complete domination of the present landscape with corn and soybeans in east central Illinois -and in the Corn Belt more generally -render it difficult for us to see, hear or imagine what nature would be doing here if no one was farming here. In this essay, we will briefly describe what nature was doing before many european-descended settlers started breaking the prairie and farming here. Secondly, we will utilize the historical record to attempt to describe some of the qualities and the dynamic of the settler's conversation with nature, as well as to hear what nature has said in response to human activities. We will attempt to understand how we arrived at our presently undesirable condition and

how the conversation might be transformed to a more desirable quality.

In retelling this history, there are several myths about pioneer agriculture that need to be exposed and refuted. One myth is that of rugged individualism. Although pioneering on the prairie was indeed difficult and required a degree of ruggedness, pioneering was more often than not a family activity and the pioneers quickly formed agricultural societies, and organized state agricultural fairs in order to share information and experiences. Furthermore, draining of the wet prairies in Illinois occurred very rapidly after the collective institution of drainage districts was created.

Moreover, a "golden age" of small independent, Jeffersonian farmers was probably short lived, (if it existed at all) and was at least concurrent with a history in which a few extremely wealthy men owned large tracts of land that they rented to share croppers. Although pioneer farms were more diversified than today's many early farmers devoted considerable acreage to production for the market. Indeed, those farmers who pioneered on the prairie needed to raise cash to buy lumber for buildings as well as to purchase increasingly sophisticated tools being manufactured in a growing industrial sector. As transportation and communication links became

more extensive, the farmers increasingly managed land in response to regional, national and global "market" signals, rather than local ecological signals. This is part of what John Bennett calls the "ecological transition".

The increasing sophistication and power of agricultural technologies also increased production faster than the demand for commodities, which put downward pressure on the prices that farmer's received for their products. When prices of agricultural commodities became very low and rural poverty high, the US government began subsidizing production and enticing abundance and diversity benefitted from these land set-aside programs only to be devastated again when, for one reason or another, high commodity prices temporarily returned. Furthermore, levee building and conversion of riparian wetlands to cropland appears to have contributed to flooding along major river systems, possibly creating more social and ecological cost than private benefits.

Based on our historical understanding, we can make several arguments for permanent retirement of large tracts of land from intensive agriculture in order to return it to near native conditions. 1) For considerable periods of time during the last half century, the quantity of agricultural production has been subsidized and has exceeded "market" demands. 2) Reclamation of riparian wetlands may

provide low cost flood control. 3) Biodiversity provides options for present and future generations. 4) Frequent, local human contact with local biodiversity is important for maintaining an open-ended human conversation with wild nature, and may help avoid possibility of a dead-ended monologue, such as occurred with the Irish potato famine.

The myth of rugged individualism might suggest that retirement and collective management of large tracts of land in the Midwest requires a level of cooperation, and institutional coordination that has not been a part of the culture of the region. However, Midwestern land owners have a long history of cooperation in the management of land resources. Rather than an absence of collective institutions for land management, the problem seem to be on of redirecting existing institutions for land management.

Recounting this history may be instructive to people in developing nations who are facing similar decisions between development and preservation that were faced by pioneers in the American Midwest 150 years ago. Furthermore, it may provide a much needed humbling perspective to US citizens who now admonish developing countries to preserve their environment: what had been a thriving tallgrass prairie ecosystem now produces corn chips and cow food right in our own back yards.

## Stand 38

### Capacity building and institutional change for sustainability the experience of the Zimbabwe natural resources management programme

Grant R. Milne  
*Zimbabwe Natural Resources Management Programme*  
Zimbabwe

Zimbabwe shares a number of common ecological/ environmental problems with many other

developing countries. Deforestation, soil erosion, loss of biodiversity, urban and industrial pollution are

key issues. Many of the rural degradation issues stem from a combination of population pressure, fragile lands, uncertain land tenure, market failure to value resources and poverty. The inadequacies of underlying environmental policy and legislation are also important factors in Zimbabwe. As well there is poorly developed capacity among resource users and managers in environmental policy, planning and economics. The need to integrate environmental, social and economic development objectives in planning, from the project to national level is critical is Zimbabwe is to successfully implement its National Conservation Strategy.

To address many of these concerns and issues, Canada and Zimbabwe entered into a five year bilateral development programme in late 1991. The resulting Zimbabwe Natural Resource Management Programme is being funded by the Canadian International Development Agency (CIDA) with nearly \$20 million CAD and is designed to assist the Ministry of Environment and Tourism in leading national progress towards sustainable development.

The programme has two projects, and

Environmental Planning and Coordination Unit (EPCU) in the Ministry head office with two Canadian advisors and five Zimbabwean counterparts, and a Research and Technical Branch (RTB) in the Department of Natural Resources with four Canadian advisors and four Zimbabwean counterparts.

The EPCU project has been very successful to date in building capacity at both the national and legislation, using a consultative approach. An interim EA/EIA policy has been developed, a major initiative at legislative reform is in progress. The Ministry is also leading the formulation of provincial sustainable development action plans, in cooperation with the World Bank, UNDP, and IUCN. A programme of policy research and analysis to support these initiatives has also been implemented.

Experience to date has provided a number of key lessons related to capacity building, institutional reform, cross-cultural effectiveness. Other countries might benefit from these experiences when planning similar steps to develop and implement sustainable development programmes and policies.

## Stand 39

### **NESSY the interactive system for ecological-economic modelling practical applications and perspectives of development**

Paul Safonov  
*Russian Academy of Sciences*  
Russia

The originally designed interactive system for building and investigating the dynamic models for different kinds of objects is under consideration. The system is primarily intended for dynamic simulation and optimal control problems and can be used as an integrated software tool for scientific research and applied studies.

On the basis of this generalized system the Nature-Economy Simulation System (NESSY) was created. Its implementation to several case studies of ecological-economic development of Russia and its

regions is considered. Perspectives of further improvement at the system are discussed.

The system includes numerous interactive tools providing:

- models specification building (using special preprocessing and linking procedures for metaextension of the high-level programming languages);
- models identification using nonlinear regression parameters estimation (e.g., for traditional economy and nature-recreating sectors) and

special computer-based methods (to obtain the coefficients for environmental blocks of the models);

- man-machine creating of development scenarios;
- data base management;
- simulation and optimization calculations using original methods and computation algorithms;
- graphics representation of the problem solving process and computational experiments results;
- easy modification of the dialogue interface using special Dialogue Constructor (DiaCon);
- context-sensitive help based on a hypertext processor and other service facilities.

A different level of aggregation models complex, implemented using the NESSY system, is proposed to study of the economic development of a large-scale region and its interaction with the natural environment.

Models of high level of aggregation are based on generalization of a Leontieff's type input-output model. The modifications considered include:

- fixed assess dynamics block, with aggregate and distributed models of delay in construction;
- several kinds of linear and nonlinear production functions, taking into account different approaches to technological change modelling, depletion of natural resources, etc.; methods and algorithms for balanced forecasting of technological structures (e.g., matrices of material expenses);

- nature block describing dynamics of the main environmental indicators (such as: air and water pollution, state of forests and soil, mineral and bio-resources etc.) with self- and artificial restoration, economic and anthropogenic influences taken into account.

For more detailed ecological processes in a region a plenty of lower level models are designed especially to describe dynamics on forests, water reservoirs, biological populations, etc.

The models and the interactive system under consideration enable the researchers and decision makers:

- To build multivariant forecasts of inventory and technological policy with the natural resources constraints involved,
- to solve the optimal planning and control problems,
- to carry out the complex ecological assessment of large-scale regional development projects.

## Stand 1

### Where has all the value gone? A critique of El Serafy's measure for adjusting GDP

Timothy Slaper  
*The American University*  
United States

The El Serafy method for correcting national income for the depletion of exhaustive resources is both conceptually and empirically inadequate. The "user cost" method suffers from an imprecise definition of "extraction cost", ignores the operational characteristics of the mineral extraction industries and requires an erroneous assumption of a fixed stock of resources. The method counts, without theoretical justification, only a fraction of the value added attributable to a natural resource as the consumption of natural capital. In addition, this method ignores the estimation of a country's stock of natural wealth.

In this paper, the El Serafy measure is compared with other valuation techniques under different market and resource conditions using a numerical example. In a context of continual investment in natural resource industries, the "user cost" method subtracts a relatively small value from gross income to derive environmentally corrected income. Finally, a comparison of the "user cost" method with other approaches is made using U.S. Petroleum and Natural Gas Extraction Industry statistics. El Serafy's sinking fund approach may make its greatest contribution in the emphasis it places on policies to invest natural resource rents in substitutes for exhaustible resources.

## Stand 2

### Energy as a measure of resource cost in systems dynamic modelling of sustainability

Grant Ryan and John Peet  
*University of Canterbury*  
New Zealand

We describe the principles behind construction of a systems dynamic process simulation model of the New Zealand economy. The approach is based upon Slesser's ECCO methodology, in which stocks and flows of embodied energy are used to follow activity in the physical economy. By this means, a range of different indices of sustainability may be determined and assessed.

Structural information and initial conditions (stocks and flows) for the dynamic model were largely obtained from an energy-modified input-

output transactions matrix and data on capital stocks in the economy.

We use the IFIAS convention, in which only nonrenewable (fossil) fuels are counted directly. The use of this embodied energy as the numeraire raises some practical problems. Values obtained for outputs ("activities") are significantly affected if either the primary energy sources shift from nonrenewable to renewable sources (the latter not directly counted in the IFIAS convention) or there are improvements in the productivity of energy use



(energy conservation). We have addressed this issue in our algorithms, by including additional "accounts" (somewhat analogous to the economist's correction

of nominal values to inflation-adjusted "real" values), to ensure that consistent and reasonable results for economic "activity" are obtained.

## Stand 3

### Valuing environmental resources

John H. Cumberland  
*University of Maryland*  
United States

Valuing environmental resources is essential in order to make rational decisions on such issues as setting environmental standards, protecting wild life habitats and cleaning up hazardous waste sites. Much recent research has addressed the restoration problem not only because of its intrinsic importance, but also because of the immense sums of money at issue in the litigation associated with oil spill and toxic waste clean-up. Leading economists, including Nobel Laureates, have recently given cautious approval to one major research methodology contingent valuation (CV) used in the valuation of resources. Social scientists have made recommendations for incorporating concepts from other behavioral sciences into CV procedures in order to improve valuation of environmental resources.

However, despite acknowledgement of the importance of the life sciences, one element which has been given inadequate weight is protocols for insuring the inclusion of concepts from ecological economics in valuation methodologies. What is needed is a transdisciplinary approach capable of addressing such operational issues as:

- The amount and location for territory which should be set aside to protect wild life habitat (e.g. in Costa Rica).
- The kind and amount of wetland to be restored to insure species diversity (e.g. in the Everglades in U.S.).
- The level of specific emissions and ambient concentration to be sought for specific pollutants (e.g. in the Chesapeake Bay).
- The priorities to be established in the rehabilitation of despoiled areas (e.g. in Eastern Europe).

The goals to be sought in this approach should include not only economic efficiency but also distributional equity, and ecological sustainability.

This topic is proposed for one on the display presentations, but can also be offered as a possible subject for a panel discussion or workshop, if others would like to participate.

## Two avenues of sustainability

Alexey Voinov  
*University of Maryland*  
United States

A simple model of an ecological economic system is suggested to investigate some of the properties of system sustainability. The variables are population, economic development, investment capital and environment protection. The investment capital is generated by taxes collected from the population and from the economic development. It is then spent for either improving the social infrastructure and thus increasing the population growth, for further development or for cleaning up the environment. Decaying environment slows down or reverses population growth. The system displays two distinct modes of development. Under high environmental priorities of the population the system equilibrates at a trajectory with low population numbers and low economic development. With higher environmental tolerance of population the

system follows a trajectory of economic and population growth, when the capital produced is sufficient both for economic development and environmental clean up. However in this case the ever-growing rates within the system eventually bring it to chaotic behavior with sharp fluctuations of investment strategies. The two modes of system development are associated with the two possible avenues of sustainability, one of which presents the sustainable development of small isolated communities in remote locations, based on native natural economics. The other avenue stands for the intensive growth in economically developed nations, that manage to keep the environmental conditions at reasonably high though artificially maintained standards due to intensive investments in clean up practices.

## Stand 4

### The economics of wildlife, conservation and conflicts

Anders Skonhoft  
*University of Trondheim*  
Norway

The paper presents a model analyzing the conflicts of wildlife management in Africa. A welldefined agency is managing a national park of fixed area. Wildlife is also assumed to be "owned" by the park authority, and this is also the agency which reapes the economic benefit from it through production of tourism services and selling of hunting licenses. The park owner clearly has economic incentives to conserve the wildlife through a management policy which seeks to balance the production activities in an optimal way. This management policy, however, does not take into

account the damages the wildlife roaming freely in and out of the park causes on the production of the agropastoralists living in the proximity of the park. The conflict is analyzed in a two species framework where the species compete for grazeland. It is shown that only the relative costs of the damages caused by the wildlife matter for the difference between the optimal stocks of wildlife resulting from the private and social optimality program. Contrary to intuitive reasoning, it is also demonstrated that a likely result will be that one of the stocks should be larger when social optimality is considered.

## Stand 5

### Ecological economic modeling for nutrient abatement with application to the Baltic Sea Drainage Basin

V. Krysanova

*Postam Institute for Climate Impact Research  
Germany*

A. Basilyev, L. Gornaja

*Tallin Technical University, Environment Information Centre  
Estonia*

Ecological-economic methods of watershed modeling in application to the Baltic Sea drainage basin can be used for development of a cost-effective strategy of eutrophication control.

A good knowledge of sources is essential to reduce nutrient inputs to the Baltic Sea. At the same time, the well-known estimates of the HELCOM divide the load into three components: direct discharge from municipal sewage, direct discharges from industrial sewage, and total river transport into the Baltic Sea. But the last component includes upstream agricultural, municipal and industrial sources of pollution, plus deposition from the atmosphere, and should be subdivided. How it can be done?

An appropriate discretization method for that could as follows: division of the whole drainage area into watersheds of main rivers, and division of larger basins like that of Narva or Daugava into subwatersheds in accordance with the existing network of hydrochemical sampling. For these areas spatio-source distribution of the load and cost estimates of the load abatement can be obtained, basing on the next GIS-layers:

- map of subwatersheds,
- land use map,
- estimates of nutrient emissions at the source for point sources and Unit Area Loads for nonpoint sources,

- evaluation of nutrient retention coefficients for different subwatersheds,
- load estimates for subwatersheds based on data of hydrochemical monitoring in rivers, and
- cost estimates of nutrient abatement measures at the source.

The aim is to make a simple generic model of nutrient retention that utilizes GIS data sets, previous results of modelling, and knowledge about chemical pathways and retention processes within a watershed. Nutrient retention is a function of the distance from the target point or waterbody and the character of the pathway (occurrence of wetlands and lakes, types of soils, etc.). Also seasonal dynamics of runoff may affect retention and cause difference for point and nonpoint sources. This approach is being applied first of all for rivers at the Estonian territory. The final objective of an international team of researchers from different Baltic countries will be to construct the nutrient retention surfaces within the whole Baltic Sea Drainage area (which will differ for point and nonpoint sources of pollution) and couple them to emissions at the source to get spatio-source distribution of the load, and after that coupling to the marginal costs of nutrient abatement measures.

## Stand 6

### Ecological deterioration and Southern Peru's development

Hugo Ordóñez Salazar  
*COSDEHT*  
Perú

This paper makes evident the limitations of a specific type of capitalist-dependent development which maximizes profit with no concern for the serious problems that they cause, by examining a case in the furthest southern point in Peru. Persistent environmental pollution and ecosystem degradation resulted from irrational exploitation by the Southern Peru Cooper Corporation in the Toquepala and Cuajone mining deposit.

These problems included: more than 2,100 tons/day of slag being dumped in the ocean and affecting 4 Kms of the "Ileño" littoral; about 180,000 tons/day of residual waters from the mining

site, of which 55.0% is composed of suspension solids, and 45.0% are liquid elements, together polluting 200 Kms of "Tacneño" littoral, and; more than 25.0% of diseases in the city of Ilo are related to bronchitis which is being caused by fumes from the foundry.

Considering the air, land, and ocean deterioration in the region, the damage caused to agriculture in the southern Peru valleys, and the pollution of water and hydrobiological resources, the direct negative effects, in economic terms, are estimated at approximately 300 million US\$.

## Stand 7

### Sustainable management of water resources using remote sensing and geographical information systems at the Reventazon Basin

Gerardo Sánchez, Robert C. Harris y Carlos Quesada  
*University of New Hampshire*  
United States

An integration of digital elevation modelling, satellite remote sensing and geographic information systems of land-cover and land-use in the Reventazon Basin in Costa Rica has been used to identify deforestation trends and possible sources of enhanced sediment erosion. The Reventazon Basin has currently two hydropower complexes in operation for a total installed capacity of 120 MW. Additionally, the basin is a major source of drinking-water for San Jose, Costa Rica's capital city. For the importance of the basin for Costa Rica's national hydropower system, a good understanding of land-

use change/hydrologic relationships is necessary for sustainable development of the region.

Drainage basins boundaries, and slope distribution maps were extracted from a Digital Elevation Model (DEM) generated from 1:50,000 topographic maps. A stratified approach for land use identification using four aggregated land use classes (forest, pasture, urban areas, and agricultural lands) was developed and applied to Landsat Thematic Mapper scenes from 1986 and 1991. The techniques described in this paper quantify the occurrence and spatial distribution of specific land

use categories as a function of slope for the basins. The remote sensing and DEM information was later combined through a Geographic Information System (GIS).

The results provide a framework for the designing of focussed field measurement and policy

programs related to soil conservation, and protection of water resources. In the Reventazon Basin these techniques could help to resolve conflicts between agriculture, hydropower generation, and water quality that are affecting the sustainable management of the basin at several reservoir sites.

## Stand 8

### Debt-for-nature swaps as noncooperative outcomes

Paul E. Chambers  
*Central Missouri State University*  
United States

The deforestation of tropical rain forests has been recognized as a global environmental problem. Recently, conservation organizations have engaged in debt-for-nature swaps in an effort to slow the rate of deforestation. This paper explains the retirement of sovereign debt of a less developed country by a conservation organization in exchange for land preservation in the absence of binding contracts. We show that swaps may be self-enforcing in that they

can arise as noncooperative equilibria. We identify the necessary conditions for the occurrence of debt-for-nature swaps. Our results are robust in that they require only assumptions of strict quasi-concavity of the utility functions. We find that swaps are more likely to occur when the opportunity cost of forgiving the debt is low, implying that the relative attractiveness of other preservation projects is also low.

## Stand 9

### An aggregate estimate of environmental degradation for Zimbabwe: does sustainable national income ensure sustainability?

Neil Adger  
*University of East*  
United Kingdom

It is now widely recognized that standard measures of economic growth do not adequately reflect changes in aggregate welfare over time. Sustainable national income can therefore be defined as Net National Product with adjustments for the degradation of renewable and non-renewable capital. Productivity loss rather than replacement cost is the most theoretically correct way to value resource

depletion. Modified net product is estimated for the agriculture and forestry sectors of Zimbabwe by valuing the loss of forest stock and soil erosion. The results show that traditional measures overstate the value of the agricultural sector's product by approximately 10 percent in 1989, due to natural resource depletion of the forestry and soil stock.

It is argued, however, that even if sustainable national income as an indicator increases over time, this does not ensure sustainable development. As with all macroeconomic indicators, sustainable national income does not account for distributional and equity issues which are at the crux of sustainable

development, nor does it point to mechanisms which would ensure sustainable resource management. Indicators are therefore a necessary but not sufficient condition for the achievement of sustainable development.

## Stand 10

### Secretariat Conference

## Stand 11

### Forests, trees and people, Phase II

Carlos Brenes  
FAO  
Costa Rica

Forests and trees are critically important for most of the rural people of the developing world, providing their principal source of energy and building materials, helping maintain the environmental stability that is needed for continued food production, yielding products that increase food security, while also providing a major source of all farm income and employment. The continued dependence of people on forestry and the magnitude of the populations involved, clearly demonstrates the vital contribution of forests and trees to people, the security of their livelihoods and the sustainability of the environment.

The number and range of needs for local tree resources are so great that they can only be successfully and sustainably addressed by growing and managing these resources at the local level in a self-help fashion by the people themselves. In order to attract and ensure continuous participation in land management decisions and tree and forest management, activities must directly benefit local

individuals. Additionally, as most of the people who are dependent on forest and tree outputs do not live in or adjacent to forests, development activities need to be as concerned with tree growing outside the forest as with the resource management in the forest.

The new dimensions of forestry focus on "integrating". Integrating forest and tree resource considerations into agriculture and grazing land-use systems, into land management and economic decisions and into the social and cultural framework of local communities. Forest and tree management systems must be designed with an awareness of the factors that will affect success. Many of the factors that influence a management system relate to the ways people organize their lives and resources. Forestry must therefore be shaped as much by the social sciences as by the physical and biological sciences.

FTPP II began in 1991 and is the culmination of previous FAO community forestry efforts, Forestry for Local Community Development (1979-86). FFTP II is a programme whose ultimate beneficiaries are local communities with increased capabilities for self-help, integrative, participatory, sustainable means for land, forest and tree management systems. The programme is designed to provide support and information to institutions and individuals involved with community forestry programmes.

FAO works with selected specialized national institutions and organizations as partners to provide on-going and strengthened support for the integrated approach. These organization network to exchange regional and global experiences, adapt methods and approaches to their specific situations, and work to strengthen other organization's and project's work with rural people by helping them use the country specific methodologies. The local institutions select activities by identifying constraints to community forestry giving priority to those issues for which there exist opportunities to address limitations. Various types of activities undertaken regionally include workshops, development of curricula and training packages with case examples, and field testing of methodologies. In this process FAO is involved in the

development of programme concepts and in the dissemination of new information.

The Forest, Trees and People Programme - Phase II is an effort to develop and make available information, methods and technical support for self-help development and the incorporation of sustainable activities. FFTP II focuses on:

- Developing new concepts and methods and making them available to local communities, projects and policy makers.
- Strengthening institutional support to community forestry by local and national organizations.
- Supporting ongoing forestry related programmes, field projects and activities in their efforts to integrate more effective participation approaches.
- Disseminating new information and experiences through networking and improved communications.

## Stand 12

**I.S.E.E.**

**International Society of Ecological Economics**

## Stand 13

**N.A.S.A.**

**National Aeronautics and Space Administration**

## **Stand 14**

**Comisión Permanente de Cooperativas de Autogestión**

## **Stand 15**

**I.C.E.  
Instituto Costarricense de Electricidad**

## **Stand 16**

**Revista Forestal Centroamericana  
Centro Agronómico Tropical de Investigación y Enseñanza  
Costa Rica**

## **Stand 17**

**Revista Vida Silvestre Neotropical**

**Miriam Carranza  
Universidad Nacional  
Costa Rica**



## **Regional wildlife management program for Mesoamerica and the Caribbean**

**Claudette Mo**  
*Universidad Nacional*  
Costa Rica

The Regional Wildlife Management Program was created in 1987 to train Latin American professionals in the wildlife-biodiversity-natural resource field, to plan, develop and carry out research, outreach, teaching and management projects. It has 3 major components: a) training at the graduate level "in-situ", b) developing model wildlife-biodiversity projects, and c) outreach through regional information and technology transfer, including a documentation center (BIODOC), an international scientific journal (*Vida Silvestre Neotropical*), and a series of books. We have graduated 31 students to date, and have had students representing 16 countries from the

Americas. The journal *Vida Silvestre Neotropical* is trilingual and aims at the important group of researchers who work in the Neotropic, including Mexico through South America, including the Caribbean. It publishes in Spanish, Portuguese, and English. The books we are offering presently are "Neotropical Wildlife: Diagnostic and Conservation Strategy", edited by Eduardo Carrillo and Christopher Vaughan, "Ecology of White-tailed deer in Costa Rica and Mexico", edited by Christopher Vaughan and Miguel A. Rodríguez, and "Aquatic Flora of Palo Verde Wetlands", by Daniel Hernández and Jorge Gómez.

## **Stand 18**

**Banco de Costa Rica**

## **Stand 19**

**I.I.C.A.**  
**Inter-American Institute for Cooperation on Agriculture**

## **Stand 20**

**Fundación Neotrópica**

## **Stand 21**

**E.A.R.T.H. .**  
**Escuela Agrícola Regional del Trópico Húmedo**

## **Stand 22**

**U.S.A. Embassy**

## **Stand 23**

**Carlos Conejo**  
*Maestría en Política Económica, Universidad Nacional*  
**Costa Rica**

## Stand 24

### Banco Popular de Desarrollo Comunal

## Stand 25

### Instituto El Milenio

## Stand 26

### Wetlands as a nitrogen sink -estimation of costs in the Laholm Bay-

Laholm Bay in the south-westerly part of Sweden is an area that suffers from severe eutrophication damage, to a large extent due to the loads of nitrogen to the bay. Implementation of cost effective measures to reduce the load of nitrogen requires knowledge of the cost functions for different abatement measures. In this paper the costs of one of these measures, wetland restoration, are estimated for the Laholm Bay area. This is done in two steps: Firstly, the abatement capacity of wetlands is estimated as a function of the load of nitrogen per surface area of

wetland. Secondly, the costs for restoring wetlands are estimated, in terms of investment cost, maintenance cost and opportunity costs of land. By relating the abatement capacity to the restoration costs, a cost function in terms of SEK/kg. N can be found.

It is concluded that for this region, the marginal costs vary greatly, according to the original land uses in areas that are being restored as wetland, and also due to the load of nitrogen on the specific wetlands.

Olof Bystrom  
Swedish University of Agricultural Sciences  
Sweden

If all the potential wetlands are restored, a maximum nitrogen on the specific wetlands. If all the potential wetlands are restored, a maximum nitrogen reduction of 990 tons per year could be achieved,

which corresponds to approximately 22% of the total nitrogen load per year to the Bay. Most of the nitrogen abatement in wetlands can be done at relatively low costs (0,5-20 SEK/Kg N and year).

## Stand 27

### A reduction of nitrogen emissions to the Baltic Sea at minimum cost

Katarina Elofsson  
*The Beijer Institute*  
Sweden

The Baltic Sea is a mutual resource of nine countries with different economic and political systems. It is the largest brackish water reservoir in the world, and its drainage basin is about four times larger than the water surface area, the latter covering about 365.000 km<sup>2</sup>. Inherent properties of the Baltic, including a relatively small mean depth and narrow and shallow connections to the sea, makes the Baltic particularly vulnerable to anthropogenic influences.

The water quality has deteriorated during the last decades due to man's activities, and eutrophication is one of the major environmental problems. It is a politically widely accepted goal to reduce the nitrogen load on the Baltic Sea by 50%. Large efforts have been put into the analysis of point sources (municipal waste water plants and industries) in the region, while non-point sources like agriculture have achieved less attention. Currently, the agricultural load of nitrogen corresponds to about 30-40% of the total load, and the costs to reduce the nitrogen load by measures in the agricultural sector is in many cases lower than the cost for reduction at point-sources.

In this paper, it is assumed that the objective of the environmental manager is to reduce the nitrogen leakage from agriculture to the coastal waters by 50% at minimum cost. This goal can be obtained by

changes in land use, improved manure handling practices, reduced consumption of chemical fertilizers and reductions in livestock holdings. The costs of reducing the leakage to coastal waters varies within the Baltic Sea region depending on nitrogen retention, soil types, current cropping pattern, total application of nitrogen on arable land and manure handling practices. For the purpose of this study, the region is therefore divided upon 17 drainage basins, from which data have been collected.

The preliminary results from the model show that it is possible to obtain the 50% reduction at the coastal waters and that the cost effective distribution of costs is correlated within the distribution of emission reductions. The cost effective distribution will differ substantially from the current distribution of nitrogen emissions to the Baltic Sea coastal waters, as the possibilities to reduce the runoff depends on the initial state of agriculture. Some countries with intensive agriculture and large nitrogen leakage, e.g. Denmark and Germany, have already implemented many measures against nitrogen leakage, and the potential for a further leakage reduction is therefore limited. Other polluters, like Poland and Estonia, have greater possibilities to reduce the leakage through improved agricultural practices; and under cost effectiveness these countries will therefore carry a larger share of the total cost compared to emissions.

## Stand 28

### **Thermodynamic implications for mineral extraction, substitution and technical change: the case of copper and aluminum in the United States**

**Matthias Ruth**  
*Boston University*  
United States

Concepts derived from thermodynamics are being increasingly promoted for an assessment of the sustainability of economic activities. Frequently, economic criteria are moved into the background of physically based models of natural resource use and pollution. Furthermore, the relevance of the thermodynamic constraints on real economic processes is not readily apparent from these models because the analyses typically have been theoretical and conceptual in nature. However, only applications to real economic processes can shed light on the relevance of the thermodynamic concepts for an assessment of the sustainability of economic activities.

Motivated by the lack of integrated approaches that do justice to both thermodynamics and economics, and the void of empirical studies combining the two disciplines, this paper provides an integrated framework for the valuation of technologies, substitution and technical change. The paper determines empirically the relationships between changes in

thermodynamic states of materials and the use of high-quality energy sources for the case of copper and aluminum mining, smelting and refining in the United States. Particular attention is given to the change in resource quality in its interrelationship with economic decisions and thermodynamic constraints.

An economic model of natural resource use and production has been developed that explicitly includes thermodynamic constraints on: i) the process of separating minerals from crude ore, ii) smelting processes, iii) substitution among inputs and outputs, and iv) endogenous technical change in mining, smelting and refining. Based on empirical information, the model has been simulated to assess outer limits of feasible resource savings in copper and bauxite mining and smelting. Policy conclusions are drawn for the role of markets, government, and science in valuing the products and effluents from mining, smelting and refining operations with regard to changes in the physical resource base and environmental quality.

## **Dynamics of New England's ground fisheries: an interdisciplinary, spatially explicit approach to the management of multiple species**

Matthias Ruth, James Lindholm, Alicia Quinby and Heather Tausig  
*Boston University*  
United States

The close interrelationships among fish populations, environmental factors and management decisions by the fishing industry and policy makers around the world are well exemplified by the current problems manifest in New England's ground fisheries. Many factors influencing the dynamics of these interrelationships are poorly understood. The ecological systems are too large and complex to conduct controlled experiments that yield sufficient insight into responses of fish populations to environmental factors and management decisions. Similarly, economic adjustments to changes in fish populations defy traditional analysis. Thus, computer simulation models are required to build on the knowledge of experts in fisheries biology, natural resource economics and environmental science to identify the driving forces in New England's fisheries and assess the consequences of alternative management measures.

Motivated by the system's complexity, a spatially explicit model of the dynamic interrelationships among fish populations, environmental factors and management decisions within New England's ground fisheries has been developed. Input to the model is derived from biometric and econometric analyses and from public records, and scientific and government publications.

The product of interdisciplinary research, the model addresses i) how management measures for one species influence the population dynamics of other commercially exploited species, and ii) the optimal size and location of fishery reserves in order to maintain viable fish populations without harming the fishing industry. Policy conclusions are drawn from a number of scenarios run to investigate the spatial dynamics of the multiple species fishery and its management.

## **Stand 29**

### **The transferability of strategies for promoting a sustainable harvest of sea turtle eggs in Latin America: applying ecological economics in a Guatemalan coastal community**

Macol M. Stewart  
*Yale University*  
United States

This paper examines the transferability of strategies for promoting a sustainable harvest of sea turtle eggs in Latin America. The ARCAS South Coast Project in Guatemala's Hawaii Marine Reserve is used as a case study for the practical applications of ecological economics in manipulating the economic incentives which drive the market for sea turtle eggs.

The high demand for sea turtle eggs, the low cost of harvesting them, and their nature as an opened-access resource have resulted in complete harvesting of virtually all sea turtle eggs laid on Guatemala's beaches - a clearly unsustainable practice which can only lead to the extinction of the local nesting population. The structure of economic incentives surrounding the exploitation of sea turtle

eggs is explicated for the purpose of clarifying the angles from which these incentives can be manipulated.

A variety of economic strategies used in other areas of Latin America and the Caribbean are evaluated according to their potential for transforming Guatemala's equilibrium of extinction in to a sustainable harvest. Incentive manipulation techniques evaluated include the present strategies for encouraging donations to a hatchery (Guatemala), as well as monopoly (Ostional, Costa Rica), moratorium (Costa Rica), mariculture (Reunion and the Caiman Islands), hiring of poachers (Brazil), indirect purchasing of eggs through a "turtle barter

market" (El Salvador), ecotourism (Costa Rica), "turtle-safe eggs", adopt-a-nest, and a conservation tournament.

Prominent realms for manipulating these incentives are resource access, market demand, collection costs, and conservation benefits (including who benefits and who pays). The strategies exhibiting the highest degree of transferability include strategies which aim to raise the cost of egg collection by increasing collectors' opportunity costs and those which enlist the beneficiaries of non-consumptive use values, existence values and option values of sea turtles to help cover the costs of conservation efforts.

## Stand 30

### Comunidad Bahai

## Stand 31

### Acid rain and greenhouse effect: the basis for a collective reflection

Nuria Castells

*Institute for Systems Engineering and Informative, European Community  
Italy*

The poster presents some results of a European research project on greenhouse effect and acid rain, and the distributive conflicts in the harmonization and implementation of environmental policy in Europe. The synthetic results present the data in relation to acid rain, with the maps of sulphur depositions in Europe and the comparison with the critical loads estimated for the territory. Based on this comparison, we discuss the discrepancy among

ecological problems according to the data, the actual policies and the social perception of the issue.

We also present the bargaining process among the different partners of the Sulphur protocol on emission reduction. This protocol, based on the RAINS model developed at IIASA, assigns to each country involved in the agreement a percentage of emissions reductions. The calculation of this *policy*

*number* and the implementation of the abatement measures have significant distributive consequences, which we discuss.

The emissions of CO<sup>2</sup> and their reduction are

also discussed, using the same approach. We present a picture of the world situation in emissions of CO<sup>2</sup> and the European policy in order to fit the international agreements. Again, the discussions in how to implement the reduction policy are presented in the poster.

## Stand 32

### Economic development in transition: modeling the paradigm shift in values from anthropocentrism to biocentrism

M. B. Neace  
Mercer University  
United States

This paper traces the shift in values that have underpinned economic development from an anthropocentric orientation toward a biocentric orientation. Drawing upon the ideas and concepts of several eminent scholars, such as Berry, Costanza, Daly and Teilhard Chardin, a series of five models are presented illustrating the primal economic and ecological models concluding with an operational model that blends the two such that sustainable economic development is possible.

The first model depicts economic behavior as generally practiced today with its emphasis on anthropocentric growth. Figures 2 and 3 portray Planet Earth as generally viewed by ecologists - a world biocentric in character with emphasis on relationships and balance. The third model is holistic

overview of the human-economic-biospheric interface, exemplifying its multidisciplinary, multistakeholder character.

A coalescing of economic and ecologic positions is advanced in the fifth model, proposing that sustainable development requires a shift from the present dominant anthropocentric linear pattern to a biocentric circular paradigm recognizing the underpinning role of the natural environment.

Discussion of the models focuses on the interconnectedness of man to all elements of the biosphere and Planet Earth (ethics) and the paradigm shift that will be essential to attain the twin goals of economic well-being and biospheric health.



## Stand 33

### Economic development and the environment

Juan R. Vargas and Ronald K. García S.  
*Universidad de Costa Rica*  
Costa Rica

## Stand 34

### Why monetary analysis cannot assess sustainability

William E. Rees and Mathis Wackernagel  
*The University of British Columbia*  
Canada

Ecological analysis focuses on the flows of free energy matter (exergy) from primary producers to sequential levels of consumer organisms in ecosystems. From the perspective, humankind, through the industrial economy, has become the dominant consumer in most of the Earth's major ecosystems. A fundamental question for ecological economics, therefore, is whether the physical output of remaining species populations, ecosystems, and related biophysical processes (i.e., critical self-producing natural capital stocks) is adequate to sustain the anticipated demands of the human economy into the next century while simultaneously maintaining the general life support functions of the ecosphere. Mainstream economics approaches the issue of adequate capital stocks through monetary analysis. However, this paper argues that conventional monetary analysis is seriously flawed when applied to the question of long-term ecological sustainability. Money flows in the economy account

for only a fraction of the exergy flows upon which the economy is dependent. Moreover, market prices (or their surrogates) for ecologically significant "goods and services" do not reflect the size of the corresponding stocks or whether there are critical minimal levels (biophysical scarcity), the functional role of such stocks in relevant ecosystems, or their ultimate value in sustaining life. In short, money is excessively abstracted from the real wealth it is supposed to represent. In developing this argument, we reject "weak sustainability" as a misleading concept and question the validity of even "strong sustainability" if measured in monetary terms. We conclude that the ecological conditions for sustainability are better assessed through direct biophysical approaches such as Ecological Footprint and Appropriate Carrying Capacity analysis. Still other indicators are needed to understand and monitor the sociocultural and political requirements of sustainability.

## The ecological footprint: a workshop on appropriated carrying capacity (EF/ACC) applications

William Rees, Mathis Wackernagel and Yoshi Wada  
*University of British Columbia*  
Canada

The Ecological Footprint concept starts from the premise that human depends on resource production, waste assimilation, and life-support services provided by nature. Securing ecological stability is therefore a non-negotiable bottom-line: nature's limited productivity is an ecological constraint within which humanity must live.

The Ecological Footprint (or "Appropriated Carrying Capacity" EF/ACC) estimates any defined community's or economy's demand on global resources and compares this with the long-term productive capacity sinks (carrying capacity) of the ecosphere. In other words, human demand is assessed directly against nature's supply.

In the long run, humanity cannot continue to consume more than nature produces. Human

activities are bound to remain within global ecological carrying capacity. To avoid the destruction of nature's productive potential, humanity's aggregate ecological footprint must be reduced to less than the total carrying capacity of the ecosphere. Analysis suggests that a substantial reduction of the *per capita* ecological footprints of the inhabitants of industrial regions becomes the first sustainability imperative.

The Ecological Footprint concept can assist achieving this goal in several ways. The purpose of this workshop is to present various applications of the Ecological Footprint and to show, with practical examples, how it can be calculated and used in political, educational, and economic contexts.

## Stand 35

**Evergreen Global Resources, In.c has the solution to the world's number one environmental issue -Municipal solid waste-**

Richard Bell  
United States

Evergreen Global Resources, Inc. has developed a Resource Recovery System that provides a way of managing large volumes of Municipal Solid Waste and of preserving the resource value of the entire waste stream. Some of the constituents may be recovered and sold as recycled material while the balance of the waste stream can be used to make finished salable products or the entire waste stream can be made into finished salable products if there is no market for recycled products.

The EGR Resource Recovery System manages and treats 100% of the waste stream; thus eliminating the need to dispose of any portion of the waste stream to landfills as is done today.

Each step in EGR's Resource Recovery System utilizes conventional apparatus and equipment now in the present day marketplace in ways that are unique to the process.

The Evergreen Global Resources, Inc. system is comprised of three areas of operation. These areas are as follows:

- Receiving, grinding, deodorizing, sterilizing, drying and compacting the entire solid waste stream and preparing it for further utilizations.
- Separation and recovery of useful products from the conditioned waste and selling these as recycled products.

● Utilizing the balance of the waste stream from that is not sold by converting these materials into finished, salable products.

The Resource Recovery System does not pollute the air, water or soil and will save millions of trees in years to come.

## Stand 36

**U.N.A.**  
**Universidad Nacional - Costa Rica**  
**Vicerrectoría de Vida Estudiantil**

## Stand 37

Peter Sjøholt  
*Institute of Geography*  
Norway

## Stand 38

**Air pollution in Chile**

Jorge Rogat  
*University of Goteborg*  
Sweden

Santiago de Chile has been suffering the problem of air pollution for many years. Natural causes, and causes induced by human activity are factors that have contributed to this development. Santiago, like other highly polluted cities in the world,

suffers from chronic periods of high pollution. During these periods people are exposed to very high levels of air contamination, which impose considerable risks to human health.

The Contingent Valuation Method (CVM) has been widely and increasingly used during the last decade. CVM is a survey-based method which through direct questionnaires aims to obtain people's willingness to pay for nonmarket goods such as services, recreation areas and natural resources, or for their preservation or restoration. In order to reach a high level of reliability, a hypothetical market scenario where environmental amenities may be bought and sold is constructed and presented to the interviewed person. The respondent is then asked about his/her willingness to pay for the good in question.

This study is intended to elicit the willingness to

pay for a 50% decrease in the level of emissions in the area of Santiago. A survey of 500 personal interviews were carried out among people living in Santiago and the vicinities of the capital. The respondents were selected through random sampling. The interviews were carried out between December 26th 1993 and the beginning of January 1994. The survey instrument used in order to obtain the maximum willingness to pay was the referendum method in a voting format with discrete questions, where respondents were asked for several values. These values were increased/decreased depending on if he/she accepted or rejected it. Finally, the respondent was asked about his/her maximum willingness to pay. The average maximum willingness to pay as a lump sum payment was about USD50.

## Stand 39

### Eco-rating: a new tool for the evaluation of ecological performance of economic activities

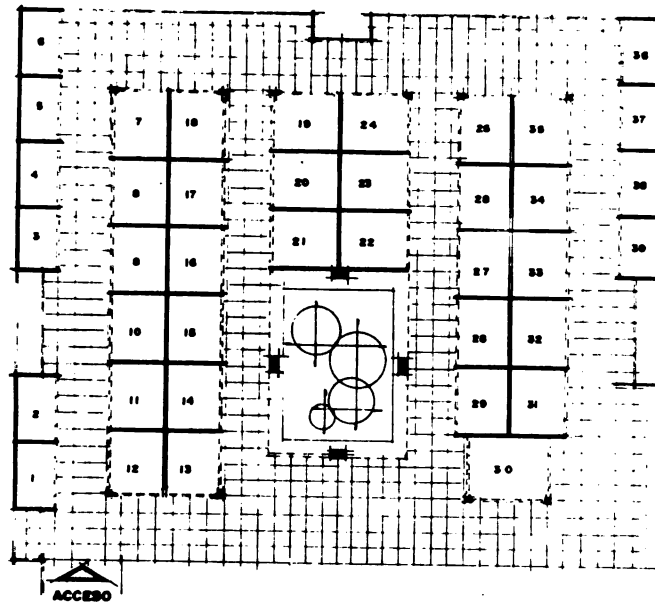
Robert Zwahlen  
*Environmental Management Consultants*  
Switzerland

Financial ratings are a well established and important tool for investment decisions. However, the environmentally conscient investor is not provided with accurate and reliable information on the environmental performance of a potential investment object. Even the growing number of green funds does not provide this information in any sufficient detail. In order to fill this gap, a new instrument has been developed to evaluate the ecological or environmental performance of a product, a production process or a firm in a standardized and comparable way. Based on a thorough ecological analysis of the entity to be rated, the result is presented on a scale reaching from -5 (environmentally detrimental) to +5 (environmentally highly beneficial). This application of a scale is one of the main differences between the Eco-rating and a "green label", which only provides a yes/no style of information without any indication of the degree of the achievement. In an accompanying report, the

result is being explained and indications are provided on strong and weak points in the environmental performance of the rated object. A positive result on the rating scale indicates that the product, process or firm is achieving a net environmental gain (NEG). The most important criteria for the evaluation are sustainability and best available technology (BAT). The rating procedure and the possible results are illustrated with a few cases.

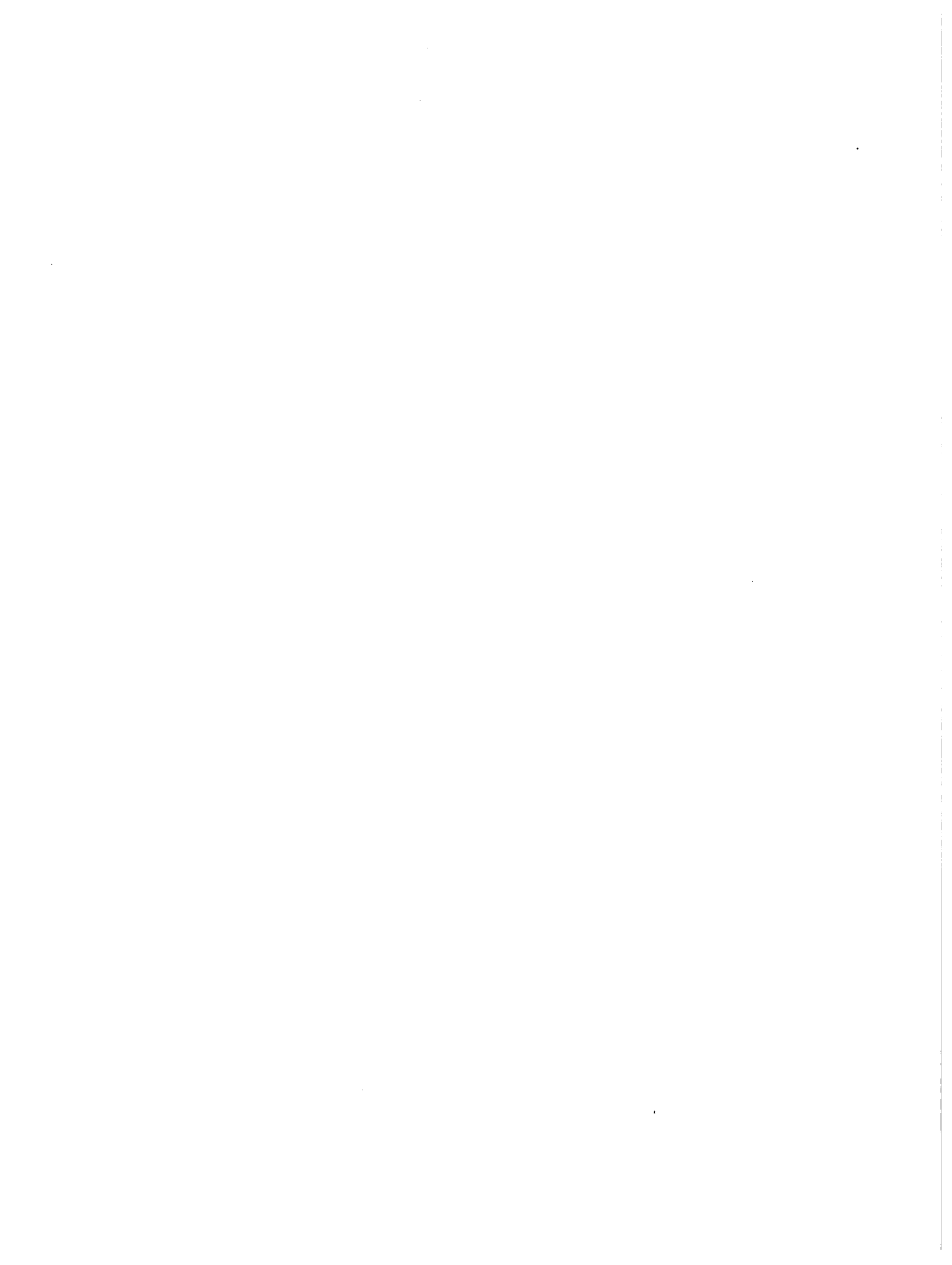
- a reforestation program with integrated timber processing plant in Costa Rica,
- a natural gas supplying company in the USA,
- a new product for oil spill decontamination from Switzerland.

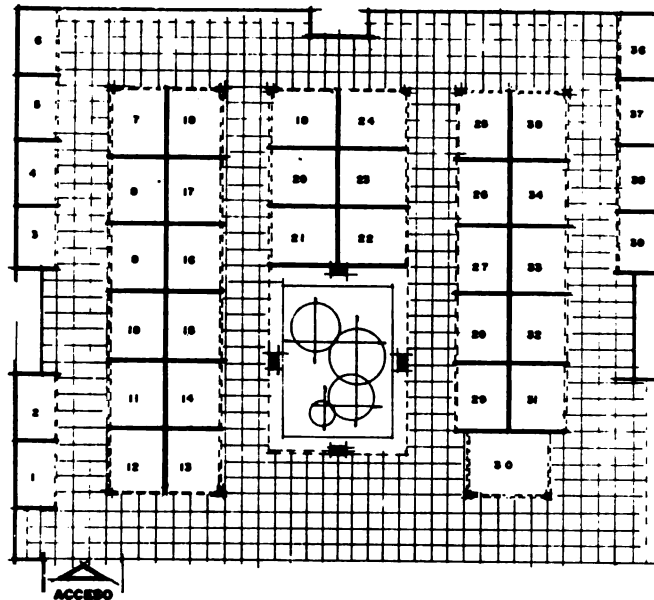
Monday 24 - Display area stand location



**MONDAY**

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| <p>1. A. Ahmad, G.B. Pant Institute, India</p> <p>2. R. Lira, Chile</p> <p>3. W. Lutz, International Institute for Applied Systems Analysis, Austria</p> <p>4. A. Yáñez and A.L. Lara-Domínguez, University of Campeche, México</p> <p>5. O. Fallas and M.M. Cordero, Universidad Nacional, Costa Rica</p> <p>6. Y. Astorga, Universidad Nacional, Costa Rica</p> <p>7. G. Sánchez, R. Harris, C. Quesada, Universidad de Costa Rica, Costa Rica</p> <p>8. E. B. DeBellevue, T. Maxwell, R. Costanza and M. Jacobsen, University of Maryland, United States<br/>L. Weinger, T. Maxwell and R. Costanza, University of Maryland, United States<br/>E.B. DeBellevue, University of Maryland, United States</p> <p>9. D. Wiersma, University of Groningen, The Netherlands</p> <p>10.</p> <p>11. J. Karremans, Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica</p> <p>12. I.S.E.E.</p> <p>13. N.A.S.A.</p> <p>14. G. Waerras, Electricité de France, France</p> <p>15. M. Collins, International Institute for Environmental and Development, Brazil</p> <p>16. Revista Forestal Centroamericana, Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica</p> <p>17. M. Carranza, Universidad Nacional, Costa Rica<br/>C. Mo, Universidad Nacional, Costa Rica</p> <p>18. V. Montero, Universidad Nacional, Costa Rica</p> <p>19. I.I.C.A.</p> <p>20. J. Barnes, World Wide Foundation, Namibia</p> <p>21. E.A.R.T.H.</p> | <p>22. U.S.A. Embassy</p> <p>23. C. Conejo, Universidad Nacional, Costa Rica</p> <p>24.</p> <p>25. Instituto El Milenio</p> <p>26. L. Zarzky, Nautilus Institute for Security and Sustainable Development, United States</p> <p>27. B. Allen, Rollins College, United States</p> <p>28. J. Ferraz, National Institute for Amazon Research; J. C. Henriques, Rio do Norte Mining Corporation; P. May, Federal Rural University of Rio de Janeiro; A. Castillo, Rio do Norte Mining Corporation, Brazil</p> <p>29. R. Twilley, University of Southwestern Louisiana; A. Bodero, Proyecto de Manejo de Recursos Costeros; R. Gottfried, the University of the South, United States<br/>R. Gottfried, the University of the South; M. Pozo, Proyecto de Manejo de Recursos Costeros; R. Twilley, University of Southwestern Louisiana, United States</p> <p>30. Comunidad Bahai</p> <p>31. T. Sterner, University of Gothenburg; Christian Azar, Chalmers University of Technology, Sweden<br/>M. Delhaj, University of Gothenburg, Sweden</p> <p>32. E. Santana Bendix, Asociación Costarricense para el Desarrollo de la Calidad, Costa Rica</p> <p>33. F. Smith and J. Roughgarden, Stanford University, United States</p> <p>34. D. Carlson and F. Tank, The University of Toledo, United States</p> <p>35. Evergreen Global Resources, Inc.</p> <p>36. R. Quiroga, Instituto de Ecología Política, Chile</p> <p>37. A. Peloso and L. Camperler, Cornell University/ University of California, United States</p> <p>38. L. Castillo, C. Ruepert and E. Solfs, Universidad Nacional, Costa Rica</p> <p>39. P. Powell, Vanderbilt University, United States</p> |
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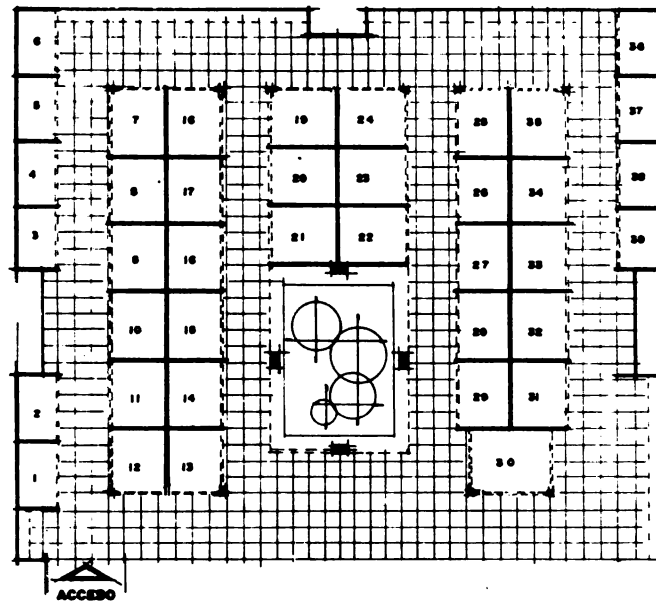


**TUESDAY**

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|---|--|
| <p>1. F. Ackerman, Tellus Institute for Resource and Environmental Strategies, United States</p> <p>2. B. Aguilar, The School for Field Studies, Costa Rica<br/>K. Besleme and B. Aguilar, St. Olaf College, United States and Costa Rica</p> <p>3. D. Tomasini, C. Alzogaray, Dirección de Conservación de Suelos, Argentina</p> <p>4. R. Alfaro, Universidad Nacional, Costa Rica</p> <p>5. S. Nandwani, Universidad Nacional, Costa Rica</p> <p>6. J. Navunga, Ministry of Environment and Tourism, Zimbabwe</p> <p>7. G. Sánchez, R. Harris and C. Quesada, Universidad de Costa Rica, Costa Rica</p> <p>8. R. Janssen, Institute for Environmental Studies, Free University, The Netherlands</p> <p>9. M. Grasso and Y. Schaeffer-Novelli, University of Sao Paulo, Brazil</p> <p>10.</p> <p>11. M. Baldares, Universidad de Costa Rica, Costa Rica</p> <p>12. I.S.E.E.</p> <p>13. N.A.S.A.</p> <p>14. R. Meir, University of California, United States</p> <p>15. J. Korning, Fundación Neotrópica, Costa Rica</p> <p>16. Revista Forestal Centroamericana, Proyecto Producción en Bosques Naturales (RENARM), Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Costa Rica</p> <p>17. M. Carranza, Universidad Nacional, Costa Rica</p> <p>18. V. Montero, Universidad Nacional, Costa Rica</p> <p>19. I.I.C.A.</p> <p>20. H.K. Konstant, University of the Witwatersrand, South Africa</p> <p>21. E.A.R.T.H.</p> | <p>22. U.S.A. Embassy</p> <p>23. J. York, Organization for Tropical Studies, Costa Rica</p> <p>24.</p> <p>25. Instituto El Milenio</p> <p>26. A. Drucker, UNICEF, Brazil</p> <p>27. I. Kogan, Intrest S.A., Costa Rica</p> <p>28. J. Echeverría, Centro Científico Tropical, Costa Rica</p> <p>29. R. Grill, Centre for Agricultural and Resource Economics, Australia</p> <p>30. Comunidad Bahai</p> <p>31. L. Vasseur, P. De Connick, M. Séguin, J. St-Germain and C. Anseau, Université de Sherbrooke, Canada</p> <p>32. H. Fitz, E. Reyes, R. Costanza, F. Sklar, University of Maryland, United States.<br/>T. Maxwell and R. Costanza, University of Maryland, United States<br/>E. Reyes, R. Costanza, M. Mageau, J. Brawley, University of Maryland, United States</p> <p>33. K. Sokulsky, M. Oelschlaeger, H. Stallworth, D. Molina, E. Johansen, D. Rodeheaver, R. Kiesling and Wendy Gordon, Texas Natural Resource Conservation Commission, United States<br/>K. Sokulsky, Texas Natural Resource Conservation Commission, United States</p> <p>34. R. Salazar, Fundación AMBIO, Costa Rica</p> <p>35. Evergreen Global Resources, Inc.</p> <p>36. T. MacLean, United States</p> <p>37. G. McIsaac and B. Hannon, University of Illinois Champaign-Urbana, United States</p> <p>38. G. Milne, Zimbabwe Natural Resources Management Programme, Zimbabwe</p> <p>39. P. Safonov, Russian Academy of Sciences, Russia</p> |
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**THURSDAY**

1. T. Slaper, The American University, United States
2. G. Ryan and J. Peet, University of Canterbury, New Zealand
3. J. Cumberland, University of Maryland, United States  
A. Voinov, University of Maryland, United States
4. A. Skonhoft, University of Trondheim, Norway
5. V. Krysanova, Postam Institute for Climate Impact Research, Germany; A. Basiley, L. Gorneja, Tallin Technical University, Environment Information Centre, Estonia
6. H. Ordoñez, COSDEHT, Perú
7. G. Sánchez, R. Harris y C. Quesada, University of New Hampshire, United States
8. P. Chambers, Central Missouri State University, United States
9. N. Adger, University of East, United Kingdom
- 10.
11. C. Brenes, FAO, Costa Rica
12. I.S.E.E.
13. N.A.S.A.
14. Comisión Permanente de Cooperativas de Autogestión
15. I.C.E.
16. Revista Forestal Centroamericana, Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica
17. Revista Vida Silvestre Neotropical  
M. Carranza, Universidad Nacional, Costa Rica  
C. Mo, Universidad Nacional, Costa Rica
18. Banco de Costa Rica

19. I.I.C.A.
20. Fundación Neotrópica
21. E.A.R.T.H.
22. U.S.A. Embassy
23. C. Conejo, Universidad Nacional, Costa Rica
- 24.
25. Instituto El Milenio
26. O. Bystrom, Swedish University of Agricultural Sciences, Sweden
27. K. Elofsson, The Beijer Institute, Sweden
28. M. Ruth, Boston University, United States  
M. Ruth, J. Lindholm, A. Quinby and H. Tausig, Boston University, United States
29. M. Stewart, Yale University, United States
30. Comunidad Bahai
31. N. Castells, Institute for Systems Engineering and Informative, European Community, Italy
32. M. B. Neace, Mercer University, United States
33. J. R. Verges and R. García, Universidad de Costa Rica, Costa Rica
34. W. Rees and M. Wackernagel, The University of British Columbia, Canada  
W. Rees, M. Wackernagel and Y. Wada, University of British Columbia, Canada
35. Evergreen Global Resources, Inc.
36. U.N.A.
37. Peter Sjøholt, Institute of Geography, Norway
38. J. Rogat, University of Goteborg, Sweden
39. R. Zwahlen, Environmental Management Consultants, Switzerland



**Additional presentations**

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**Monday 24**

Room

- 7:00 pm     **Film**  
● *Ecological Design: Investing the Future*  
Free admittance     La Paz
- 7:00 pm     **Presentation of the book**  
*Café y Desarrollo Sostenible*  
by Boyce J. Fernández, Fürst, E. y Segura, O.     La Selva

**Tuesday 25**

- 7:00 pm     **Roundtable**  
Open dialogue with peasants and indigenous groups from Costa Rica     Girasol
- 7:00 pm     **V Congreso de ALACEA, Asociación Latinoamericana y del Caribe de Economistas Agrícolas**  
● Coord.: Carlos Pomareda     La Selva
- 7:00 pm     **Developing biophysical models for resource management with special application for developing countries**     El Futuro
- 8:00 pm     **Ecological economic course roundtable**  
*Revising the old, inventing the new*     Las Américas  
● Panelists: José Cabrera Tremiño, Lillenor Lewan, Leslie King, Paul Christensen, Eban Goodstein and James French  
● Co-chairs: Winifred Armstrong, Faye Duchin

**Wednesday 26**

- 7:00 pm     **Film**  
● *Natural Parks of Costa Rica and Natural Resources*  
Free admission     La Paz
- 8:00 pm     **Presentation of the book**  
*Ecología y Capital* by Enrique Leff     Las Américas  
● Speakers: Juan Martínez-Allier, Pablo Gutman, Víctor Toledo, Fernando Tubela, Gilberto Gallopín  
● Chair: Olman Segura

**Other activities:**

Multi and bilateral meetings

**Room:**                      Jazmín and Fushia  
**Time:**                        Available  
**Contact:**                    Information desk

## Monday 24

- 8:00                      **Opening ceremony**                      La Paz
- National University Choir
  - Director: Juan Israel Carrillo
- 
- Audio-visual presentation
  - Mayra Bonilla
- 
- Dance Troupe - Danza UNA
  - Director: Elsa Flores
- 3:30 - 4:00              **Coffee break**
- University Choir UNA                      Display area

## Tuesday 25

- 3:30 - 4:00              **Coffee break**
- Marimba Universitaria                      Display area
- 8:00 p.m.                **Folkloric Fantasy**                      Melico Salazar Theater (San Jose City)

## Wednesday 26

- 8:00 p.m.                **Concert**                      Lobby, Conference Center
- Marimba Nacaome
  - Marimba Universitaria

## Thursday 27

- 3:30 - 4:30 p.m.        **Coffee break**
- Adobes Group                      Display area

# **A** nnexes



## La Selva Biological Reserve

La Selva is a privately owned, easily accessed tropical rainforest research station under the auspices of the University of Costa Rica and a large number of North American Universities. It comprises the lowland portion of a contiguous virgin forest which ranges to mountains of Braulio Carrillo and is considered one of the finest examples of tropical Atlantic rainforest in Costa Rica. Visitation is restricted to small numbers.

7:30	Departure from San Jose
9:00	Arrival Coffee Break
9:30	Presentation about Selva Verde, by Bruce Young
10:00	Brief presentation by researchers <b>Jeremy Haggard:</b> Designing sustainable agricultural systems for the tropics. <b>Antje Weitz:</b> Effects of changes in land use on the emissions of greenhouse gases. <b>Pablo Camacho:</b> Experimental forestry with native and exotic tree species. <b>Patricia Folgarait:</b> Herbivore and pathogenic reaction to native tree plantations.
12:00	Lunch
13:00	Forest Hike No. 1: Oriental trail No. 2: Tres Rios trail No. 3: Sura trail No. 4: Experimental trail No. 5: Cantarana trail
15:00	Snack
15:30	Departure from Selva Verde
17:30	Arrival at hotel

## E.A.R.T.H.

E.A.R.T.H. is developing an applied research program in response to the urgent need to find viable and sustainable agricultural practices for the humid tropics. Such investigations are essential to the objectives of the Academic and Continuing Education Programs. Proposed research will be oriented to yield applicable and immediate results for sustainable agriculture in the region.

The Colill use its academic farm, commercial farm and other facilities in this search for sustainable technology and practices to address the problems. Some of the research projects to be carried out in the near future include pest management and the misuse of agrochemicals, the generation and disposal of agricultural wastes, deforestation and pasture degradation.

7:30	Departure from San José, Coffee Break in Route
9:30	Welcome at Education Center
9:45	Presentation of Institutional video and distribution of printed information
10:00	Begin tour: the group may be divided up depending of the number of visitors
14:00	Visit library, computer center, student center, classroom, laboratory, permanent education center. Souvenir shops.
16:00	Departure from E.A.R.T.H.
18:00	Arrive at hotel

## Carara: Nature's Dreamland

As a transition zone, Carara Biological Reserve offers an incredible variety of plant life. In the dry season it stands out as fresh, green oasis. Its marshes, formed by seasonal flooding of the Grande de Tárcoles River, are especially rich in waterfowl, amphibians and reptiles. As you walk through the reserve, under the canopy of giant trees, you will have ample opportunity to see rare monkeys, coatis, crocodiles and a wide variety of birds.

- 7:00 Departure from San Jose, Coffee Break on route
- 9:30 Arrival at Carara Biological Reserve
- 9:45 Presentation conference from the reserva's director
- 10:00 Walk through the reserve
- 12:00 Departure to Punta Leona Club
- 13:00 Lunch
- 14:00 Time off to enjoy the white sand beach and surroundings
- 16:00 Departure to San José
- 18:30 Arrival at hotel

## Hacienda La Pacífica

On 1986 Mr. Stephan Schmidheiny bought this farm in order to help develop new techniques for sustainable production. More than 35% of the farm is still preserved as forest and interacts with cattle and agricultural activities. The Ecological Center Association was funded in La Pacífica farm, It's main objective was to create a model for a sustainable development at the Dry Tropical Forest. It should have an ecological basis and economical viability, gathering the different aspects of agriculture and cattle activities with production, conservation, research, education, even eco/tourism.

- 6:30 Departure from San Jose. Coffee break on route
- 9:30 Arrival at Hacienda La Pacifica
- 9:45 Coffee break
- 10:00 Conference about La Pacifica Project
- 10:30 Visiti to Asparagus Project
- 12:00 Lunch
- 14:00 Visit to feed lot
- 15:30 Coffee break
- 16:00 Departure to San Jose City
- 19:00 Arrival at hotel



## Braulio Carrillo National Park

One of the most rugged zones in the country, Braulio Carrillo National Park straddles the continental divide and descends toward the Atlantic Coast. Its tall mountains and steep slopes, covered by dense forest, provide a very important watershed for Atlantic lowlands. A visit here provides an excellent opportunity to sample a variety of life zones from high mountain cloud forest to dense lowland jungle. You will enjoy rivers and a few of the multitude of waterfalls plummeting from high cliffs to the lush green sea of tropical vegetation below. The seven life zones in the parks provide habitat for a profusion of wildlife including monkeys, wildcats, huge blue morpho butterflies, the resplendent quetzal, known as the phoenix of the forest, and the solitary eagle and the osprey can be spotted from the overlooks. You will explore different trails and encounter many of the marvels of the rain forest.

- 7:30 Departure from San Jose City
- 9:30 Arrival at Braulio Carrillo National Park
- 9:45 Coffee break
- 10:30 Presentation about the National Park
- 12:00 Lunch at the Restaurant "Puente del Atlantico"
- 14:00 Return to San Jose City
- 15:30 Arrival at hotel

## CATIE - Centro agronómico tropical de investigación y enseñanza

CATIE, research and training (Master Degree, short intensive courses, in-training service) efforts address the management and sustainability of tropical and subtropical ecosystems. It focuses on management of natural forests, agroforestry, integrated management of natural resources and promising tropical crops. Research at CATIE is distinguished by a multidisciplinary approach with a staff of about 200 professional from 25 nations. All activities rely on scientific, technological, socioeconomic and cultural criteria to ensure techniques are appropriate to users. Research and training activities are carried out in all Central America countries, in 2,000 acres of experimental land and in the Center laboratories at Turrialba.

- 8:00 Departure from San Jose City. Coffee break on route
- 10:00 Arrival at CATIE  
Welcome from the Director, video presentation and distribution of written material
- 11:30 Coffee break
- 12:00 Presentation and discussion about different projects at CATIE
- 14:30 Lunch
- 16:00 Return to CATIE's facilities
- 17:00 Return to San Jose City
- 18:30 Arrival at hotel

## The Central American School of Animal Husbandry (E.C.A.G.)

Everybody wants to visit Costa Rica's National Parks. But why would anyone spend a vacation day at a ranching college? Well, it could be E.C.A.G.'s picturesque setting in the rolling hills, just outside Atenas - only 45 minutes from San José.

With burgeoning populations, there is an ever-increasing demand to be reconciled with the very real need to preserve the planet's biodiversity. For more than ten years, experts at the Central American School for Animal Husbandry have been working on the challenge. They have developed strategies and techniques for an integrated style of ranching that will not only help save the rainforest but also solve some major environmental problems. During our one day tour you will learn how earthworms turn animal waste and garbage into rich, fertile soil; how sheep can help soil restoration; how cattle live in harmony with forest; how pigs provide food for steers; how ranchers can promote natural reforestation. In short, how food production can be part of the solution - not part of the problem.

- 8:30 Departure from San Jose City
- 9:30 Arrival at E.C.A.G.  
Welcome from the Director and presentation about the school
- 10:00 Tour of the dairy products plants and tasting
- 10:30 Hike to the Sustainable project: Iguanas, aquaculture, worms
- 11:45 Visit soil restoration and forage project
- 14:00 Visit ornamental plants and forestal species
- 14:30 Tractor tour of the school's reforestation area
- 15:30 Coffee break
- 16:15 Departure to San Jose City
- 18:00 Arrival at hotel

## La Marta Wildlife Reserve

La Marta Wildlife Reserve is an antique livestock of 1300 hectares. This was under exploitation during the last century. ULACIT Foundation put it under protection to develop conserving activities research and production under the sustainable development conception, including the participation of neighboring communities.

This is a forestry area where the development and the regeneration of natural ecosystems in the Caribbean is possible between 730 and 1950 meters with high rates of rainfall. Furthermore, it has a border with The Amistad Biosfere Reserve constituting part of the buffer area and an extension of biological corridor.

There exists a special interest in applied research for biodiversity as well as the development of productive sustainable projects (ecological tourism, species' sanctuaries, eco-museum, diverse reforestation, forest management, etc) which can be used as a model for the neighboring communities and other protected areas.

- 6:00 Departure from San Jose City
- 19:00 Arrival al hotel

## **Britt tierra madre organic coffee farm tour**

The organic Coffee Farming tour is an all-around visit to a working farm and wet mill certified by the Organic Crop Improvement Association.

7:30 Departure from San José City

18:00 Arrival at hotel

The tour begins at an organic coffee plantation in San Rafael de Heredia. Several questions and answer periods are scheduled throughout the tour with an agronomist. The tour members are also invited to tour the organic wet milling process at the "Tierra Madre Beneficio (mill)". After visiting Tierra Madre Beneficio, visitors will proceed by car to the Coffeetour.

The tour is offered to people with a special interest in organic farming and ecology.

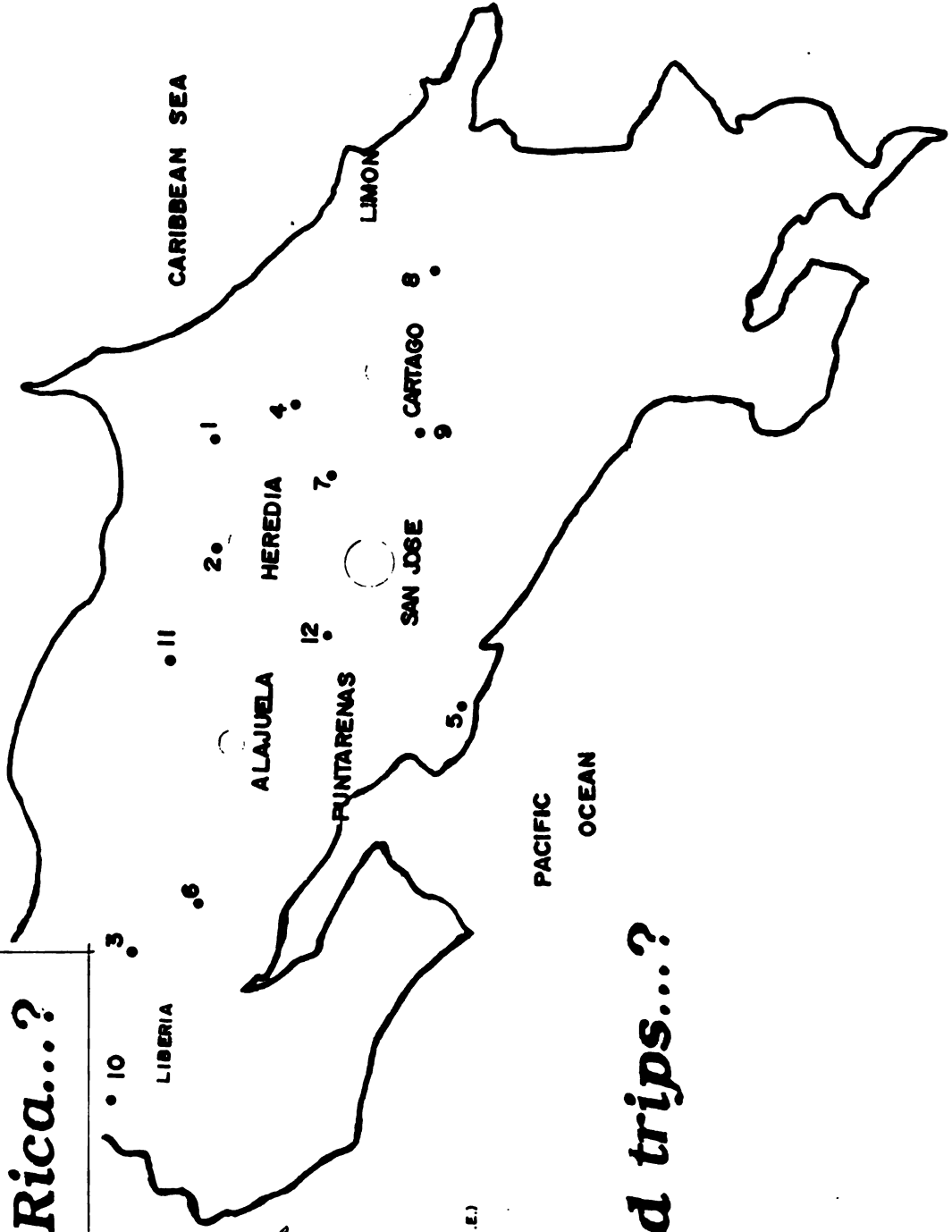
### **Suggestions**

For all these field trips, we suggest that the participants take with them:

- ◆ Extra clothes
- ◆ Hiking boots, comfortable shoes for walking
- ◆ Hat
- ◆ Raincoat
- ◆ Insect repellent

**Where**

**...is Costa Rica...?**



- 1 LA SELVA BIOLOGICAL RESERVE
- 2 BRITT ORGANIC COFFEE FARM TOURS
- 3 MIRAVALLS PROJECT
- 4 E.A.R.T.H. UNIVERSITY
- 5 CARARA: NATURE'S DREAMLAND
- 6 LA PACIFICA
- 7 BRAULIO CARRILLO NATIONAL PARK
- 8 CENTRO AGRONOMO TROPICAL DE INVESTIGACION Y ENSEÑANZA (C.A.T.I.E.)
- 9 LA MARTA: WILD LIFE RESERVE
- 10 GUANACASTE CONSERVATION AREA
- 11 PORTICO
- 12 E.C.A.S.

**are the field trips...?**

## **Universidad de Costa Rica**

Created in 1940, University of Costa Rica is the oldest and largest institution of higher education in the country. UCR offers academic degrees at both graduate and undergraduate levels. Research programs and graduate studies are part of a Research System which coordinates the activities of 28 research institutes and centers, 10 experimental stations, and several support units, including the library complex.

The following are some research centers that may interest for the ISEE Conference Participants.

- **Environmental Pollution Research Center**
- **Agronomy Research Center**
- **Lankester Garden (the goal is preserving the local flora especially orchids, bromeliads, aroids and the natural forest)**

## **Universidad Nacional**

The Universidad Nacional is an autonomous institution of higher education whose fundamental goals are:

- to contribute to the definition of a new cultural unit and of a set of national hopes which characterize the process of sustainable development
- to cultivate and communicate the concept of sustainable development within the sciences, liberal arts, and the fine arts
- to promote the integrated development of the members of the university community and offer them a humanistic education based on consideration of Costa Rican natural life, and on the themes and achievements of world cultures
- to promote the social transformation and economic development of Costa Rica, thereby contributing to the formation of a more prosperous, just, and free society, including the sustainable use of our environment and natural resources
- to contribute to the improvement of democracy and participation of the working classes in decision-making and in the benefits of development

## **IICA, Inter-American Institute for Cooperation on Agriculture**

It is composed of 33 Member States, through which the ministries of agriculture guide and evaluate the rural well-being and development of Latin America and the Caribbean. Its main objective is to develop the agriculture and livestock industries and to promote the well-being of rural populations through work programs that give priority to sustainable development, efficient agriculture and livestock production, and the equitable distribution of benefits. Visitors will learn about IICA's achievements over the last 50 years.

## **University for Peace**

The University for Peace was created by an unanimous resolution of the United Nations on December 5, 1980. As an international institution, it is dedicated to the search for peace by means of education and research in such fields as human rights, resolution of conflicts, communication, and natural resource management. The development of sustainable land use systems, within the context of natural resources

management, is of particular interest for achieving political stability and the promotion of peace, since this may reduce conflicts between individuals, groups, or even countries while directly or indirectly contributing to the quality of life of large population groups. The courses given at the Natural Resources Areas of the University for Peace complement other courses on similar subjects, in as much as the University emphasizes the human aspects of appropriate land uses and stresses the potential for harmonious human development. The courses scheduled for the current year are:

- buffer zone management for protected areas
- tourism management on protected areas
- enhancing the value of tropical natural forest through non-timber products and services
- conflict resolution in natural resources management
- trees and sustainability of agroecosystems: biological, economic and sociocultural benefits

## **INBIO, Instituto Nacional de Biodiversidad**

A non/profit association with the following goals:

- to contribute to the perpetual conservation of Costa Rica biodiversity, promoting its intellectual and economic value to society through the generation and dissemination of plant species, animals, and micro-organisms of the country
- to take inventory of the Costa Rica biodiversity
- to organize and to structure the resultant information and to promote its dissemination worldwide.

## COSTA RICA: General Information

Located on the land bridge between North and South America, Costa Rica features an impressive diversity of flora and fauna within a relatively small area. A progressive system of National Parks, Reserves and others areas under private protection offers visitors the opportunity to explore cloud and rain forest, active volcanoes, marshlands, rivers and miles of unspoiled beaches. The following is the relevant information:

<b>Size:</b>	53,000 Km <sup>2</sup>
<b>Population:</b>	3,500,000
<b>Borders:</b>	Atlantic Ocean on East; Pacific Ocean on West; Panama on South; Nicaragua on North
<b>Altitude:</b>	From sea level to 3820 m, Conference site is located at a height of 1,100 m.
<b>Volcanos:</b>	112 Craters, four active, Poas has one of the world's biggest craters, while Arenal is one of the world's most active volcanos.
<b>Birds:</b>	850 species
<b>Insects:</b>	35,000 known species
<b>Plants:</b>	9,000 known species
<b>Orchids:</b>	1,100 varieties
<b>National Parks:</b>	30% of the land is protected in national parks and reserves
<b>Ecosystems:</b>	Countless' different ecosystems include: tropical dry forest, seasonally deciduous forest, rain forest, mangroves, wild rivers, jungle canal network, wetlands and lakes, high altitude Andean "paramo".
<b>Climate:</b>	We have basically two seasons, Dry (from December to April) and Wet or Green (from May to November). Even during the Wet Season, normally it rains only during the afternoons.
<b>Temperature:</b>	Varying from 25-25 C° (80-95 F°) in dry season and to 18-25 C° (64-80 F°) in the wet season. It is recommended to bring an umbrella.
<b>Currency:</b>	The local currency is the colon. The current exchange rate should be around 160 colones per US \$ 1. Dollars can be changed easily to colones and viceversa at the airport, hotel, and banks which are open from 9:00 a.m. to 3:00 p.m.
<b>Electricity:</b>	Electric current in Costa Rica is 110 volts, AC. The outlets are American-style, but often do not have plug for grounding prong.

### Traveling within Costa Rica:

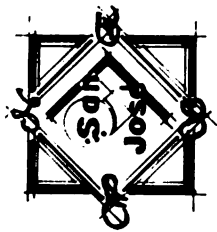
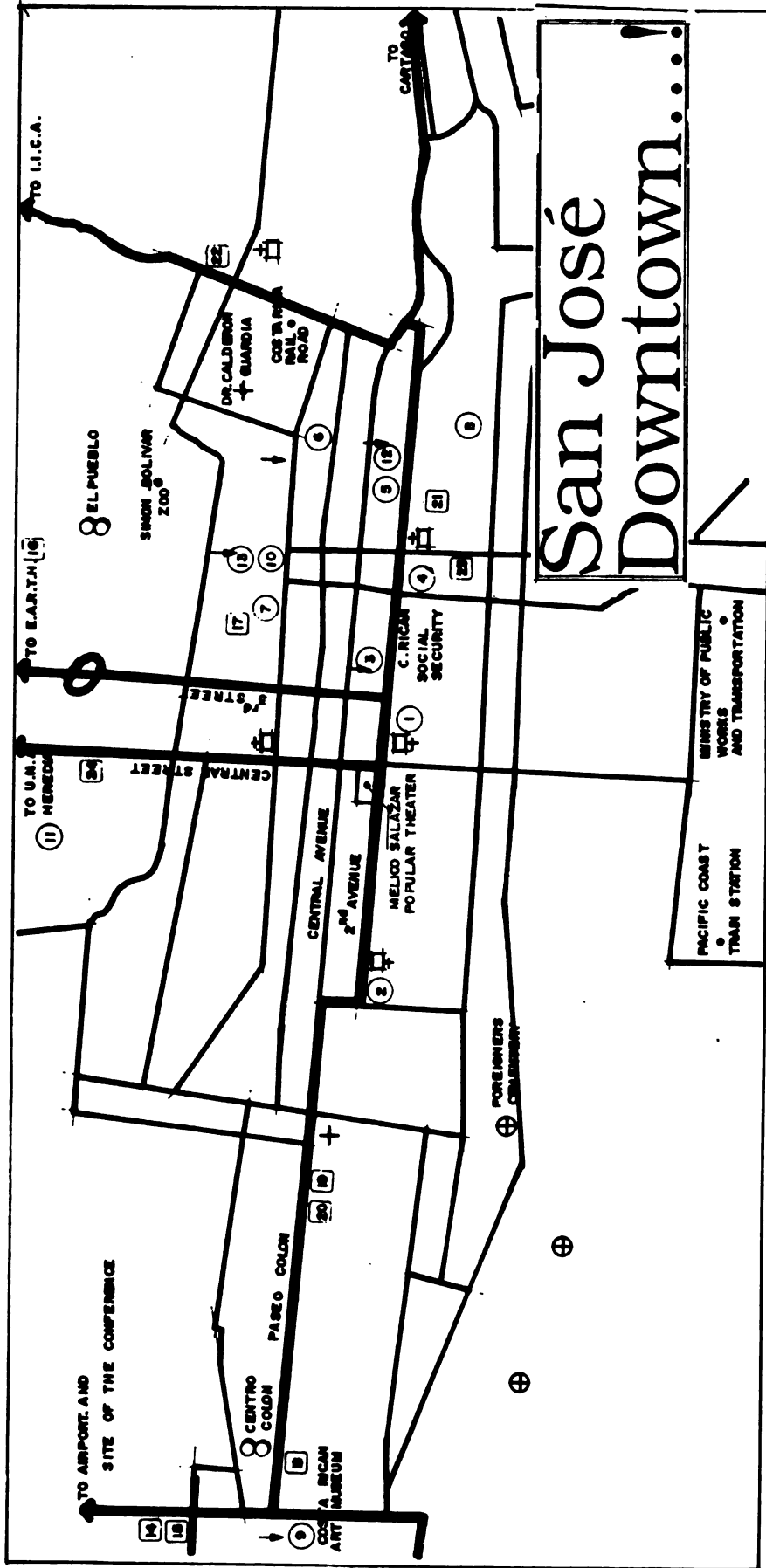
There are many car rental companies in Costa Rica. At the airport or during the Conference, there will be a car rental desk. Driving is on the right in Costa Rica and can be a challenge for the newcomer. Until you are used to the roads and local driving habits, it is a good idea to avoid driving at night, especially outside the city. Never leave anything of value in a parked car, even if it is locked, not even in the trunk. The meters, called MARIAS, are required by law in all licensed taxi. At present, the meter charges 80 colones for the first kilometer and 35 colones for each kilometer after that in the city. The price for longer rides must be negotiated. It is best to bargain for a price before you get in.

**Tourist Places:** After the Conference you may like to spend few days for Costa Rica tours, we will recommend you to contact TURVISA, the official tour operator. Phone: (506) 257-4911 Fax: (506) 222-2213 for more details. During the Conference they will be a provided desk where you can get tourist information and make reservations. In the next page you will find some tours that you may enjoy.





# What to visit in.....



- ☩ CHURCH
- ⊕ GRAVEYARD
- + HOSPITAL
- ↓ CULTURAL INTEREST
- ⊗ SHOPPING CENTER

- 1 — CENTRAL PARK
- 2 — B. CARBILLO PARK
- 3 — CULTURAL SQUARE GOLD MUSEUM NATIONAL THEATER
- 4 — LA SOLEDAD SQUARE
- 5 — LA DEMOCRACIA PARK
- 6 — NATIONAL PARK
- 7 — MORAZAN PARK

- 8 — JUSTICE SQUARE
- 9 — METROPOLITAN PARK LA SABANA
- 10 — ESPAÑA PARK
- 11 — CHILD'S MUSEUM
- 12 — NATIONAL MUSEUM
- 13 — JADE J. MUSEUM
- 14 — THE LOBSTERS INN

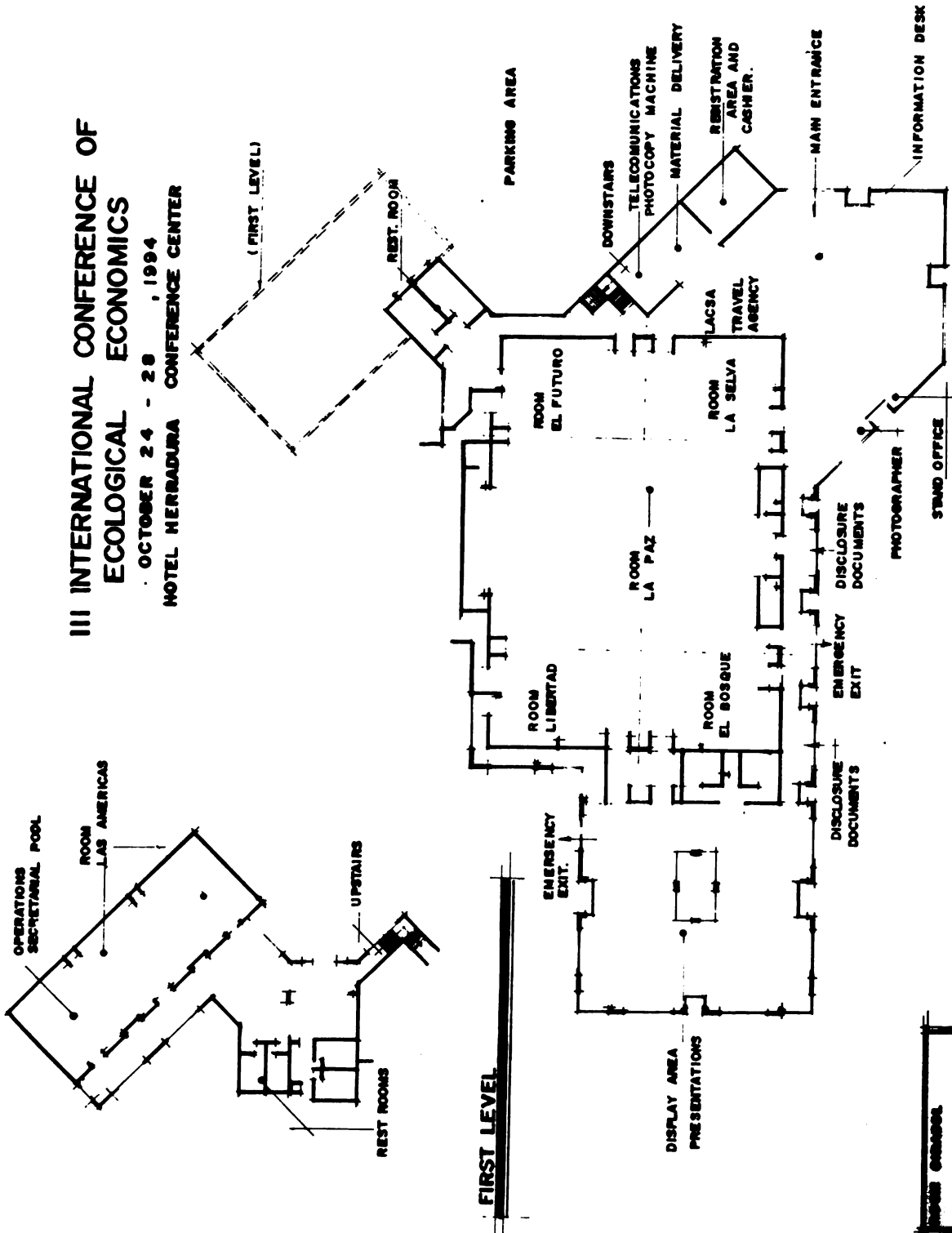
- 15 — LA GONDOLA COROBICI HOTEL
- 16 — RIAS BAJAS EL PUEBLO SHOPPING CENTER
- 17 — EL MIRADOR AUROLA HOLIDAY INN
- 18 — LA MASA DEL TRUQUEL
- 19 — THE LOBSTERS INN

- 20 — LA BASTILLE
  - 21 — THE FLEUR DE LYS
  - 22 — ZERMATT
  - 23 — TIN — JO
  - 24 — KAMAKIRI
  - 25 — GRANO DE ORO
- AND MANY OTHERS MORE !



# III INTERNATIONAL CONFERENCE OF ECOLOGICAL ECONOMICS

OCTOBER 24 - 28, 1994  
HOTEL HERRADURA CONFERENCE CENTER



UNDER GARAGE  
AT THE HOTEL, IN FRONT  
OF THE SWIMMING POOL



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