The Road from Rio

Environment and Development Policy Issues in Asia

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Editors

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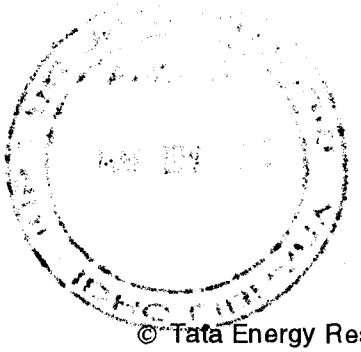

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Foreword

The United Nations Conference on Environment and Development (UNCED) was a landmark event—for those who agree with its deliberations and conclusions and those who do not acknowledge it
as a significant development for several spheres of human action. Its success or failure, therefore, need not be judged narrowly in terms of success or failure of the Conference itself, but in terms of the processes that it signifies and that it may have set in motion as a result. UNCED, of course, has raised more questions than provided answers, as might have been anticipated. Most of the concerns and questions that have been raised are generally global in nature and others are purely regional or local. But, of course, if the future health of the planet depends on forging effective partnerships, then the identification and articulation of concerns on environment and development should rightly be much wider than those that are relevant to specific sites or countries.

The 'Post-UNCED Seminar on Environment and Development Policy Issues in Asia' was designed and organised in Delhi in this very spirit. It was felt that since the future of the planet lies in the success of the partnerships mentioned above, it would be relevant to focus on the Asian region as a whole and assess the implications of UNCED for Asia, both in terms of opportunities and responsibilities. The Asian continent is a unique combination of diverse cultures, economic capabilities and production systems. On the one hand, Asia contains a highly efficient and modern industrial state such as Japan, and on the other, it is home to large numbers of people living in the worst state of poverty and deprivation. Concepts of international cooperation cannot find a more interesting region for application and implementation than Asia. But to bring about cooperation both within the region and in relation to the rest of the world, it was felt that researchers, policymakers and thinkers in the Asian region should meet and analyse the deliberations held at UNCED and the documents that were produced at the Conference. Consequently, the Seminar itself was organised around a set of selected themes on which detailed papers based on adequate indepth analysis were presented and discussed.

The Seminar organisers were fortunate to get the views and wisdom of select eminent persons during the Inaugural and Valedictory Sessions, namely, the Hon'ble Shri K C Pant, Chairman, Tenth Finance Commission; Mr R S Pathak, Former Chief Justice of the Supreme Court of India; Hon'ble Dr Manmohan Singh, Finance Minister; and Hon'ble Shri Kamal Nath, Minister of State for Environment and Forests. The former two distinguished persons addressed the Inaugural Session and the latter two, the Valedictory Session, during which the summary of discussions and deliberations in the Seminar were also presented for their consideration.

The deliberations of the Seminar were distilled in the form of concise reports by three working Groups, each of which dealt with (i) Implications of the Rio agreements and the future path of negotiations on protocols and institutions; (ii) Formulation of national/regional strategies in pursuance of the Rio agreements including Agenda 21; and (iii) Scope for regional cooperation and capacity building for sustainable development. In addition, the Seminar also saw the finalization and release of a *Compact on Sustainable Development Concerns in the Asian Region* which has subsequently been signed by a select group of distinguished persons in the Asian region, for release to the rest of the world, embodying the spirit in which environment and development actions and decisions will have to be pursued in the future.

Given the complexities of the subjects covered by UNCED, papers presented covered Agenda 21, the Framework Convention on Climate Change, the Convention on Biodiversity and various legal and administrative issues related to global environmental problems and their solutions. The Seminar was perhaps the first event held in Asia to focus on the post-UNCED global scenario and develop an Asian perspective. The following pages contain much useful material which, it is hoped, would add to the growing wealth of literature in an area of some consequence to humanity. It is also hoped that the publication of this volume would also support the larger objectives of fostering cooperation among countries in the field of environment and development, in the absence of which solutions would fall far short of what is essential to preserve the health of this planet and for human civilisation to progress.

New Delhi
April 1993

(R.K. Pachauri)

Preface

It is possible that future historians may view the United Nations Conference on Environment and Development (UNCED) held at Rio de Janiero in June 1992 as the end of the beginning of a long global swing to sustainable development. In other words, that at Rio the world community finally garnered the political courage to alter the course of growth to avoid potential future catastrophe, though not as yet, to restitute the environmental damage already accomplished. Such a view would strike a balance between the two opposite poles of opinion of observers who are still close to the event: that Rio was an unmitigated disaster, an environmental Dunkirk in which countries collectively made no firm commitment to eschew unsustainable activities and growth paths. Alternatively, that it was a spectacular success, a Normandy beachhead in the war to secure the environment, enabling the world to put in place a long-term cooperative agenda for global action.

Rio was about 'sustainable development'. However, neither the Rio Agreements themselves, nor the myriad workshops, seminars and negotiating sessions which preceded it attempted anything like a formal, comprehensive definition. While there is broad agreement on the core of the notion of sustainable development, summed up by the Brundtland Commission (1987) as development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs', several conceptual elements radiate outwards from this focus. These have been the subject of intense debate in the entire UNCED process: intellectual, ethical, legal, and political. In this debate the Rio Agreements, i.e., the Rio Declaration, the Conventions on Climate Change and Biodiversity, Agenda 21, and the Forestry Principles Statement, settle some issues, but immediately raise new ones. Three pillars of the post-Rio order, are however, now firmly in place. First, that sustainable development is about the rapid elimination of the dire poverty in which billions of people in developing countries remain mired, despite political independence, and considerable development efforts. Second, that it concerns the welfare possibilities of future generations, and that resources, i.e., natural endowments as well as capital and technology, must be bequeathed to them in sufficient measure. Third, that while all countries have responsibilities towards the global environment, the industrialized countries must take the lead in committing financial and technology resources, both on account of their greater historical and current levels of use of global environmental resources, as well as their greater present capabilities, acquired in part, from use of environmental resources.

After Rio, the debate has not ebbed. What are the appropriate principles for sharing global resources across countries and generations? What are the feasible policy instruments for giving effect to such principles? What are the bases for financial and technology transfers to developing countries to enable them to contribute to conserving the global environment? What are the appropriate institutional structures for channelling such transfers? What are the likely economic and social costs to different countries in meeting their respective commitments? What is a likely menu of response strategies in a meaningful policy planning time horizon? Indeed, what is an 'appropriate time horizon' for global policy making? Issues such as these, and others, continue to demand time, energy and attention from researchers, policymakers, and serious activists.

The present volume brings together the perspectives on this debate of a number of international professionals: researchers and policymakers, many of whom were personally involved in the UNCED process, as well as their consensus on several broad

courses of action. These were formulated and presented shortly after Rio, in the 'Post-UNCED Seminar on Environment and Development Policy Issues in Asia', organized in October 1992 at New Delhi. The seminar being focused on Asia, the deliberations, reflected in this volume, largely articulate the concerns of developing and newly industrializing economies.

The papers in this volume cover a wide ground: issues of political economy, institutional design, response strategies, means of financial and technology transfers, economic implications, besides critiques of the major Rio Agreements. It also incorporates the perceptions of the senior political leadership in India on the global environmental debate, contained in several speeches made at the inaugural and valedictory functions of the seminar. The contents, it is hoped, will stimulate further thought and work by readers with a serious interest in the global environment.

(Prodipto Ghosh) **(Akshay Jaitly)**

New Delhi
April 1993

Acknowledgements

A large number of individuals and organizations contributed at several stages and in various ways to the successful conduct of the Post-UNCED Seminar, and the preparation of this volume. There is no way in which they could all be thanked, or even named.

In particular, the editors wish to acknowledge the valuable support, moral and financial, received from the United Nations Development Programme, and the International Development Research Centre, Canada.

Without the efforts of the numerous authors and the participants, the seminar would not have made any headway. The smooth conduct of the plenary and working Groups sessions was made possible by the wise helmsmanship of the respective Chairpersons. The success of the seminar owes much to the presence, and thought provoking observations of the Speakers and presidents at the inaugural and valedictory sessions, Mr K C Pant, Justice R S Pathak, Dr Manmohan Singh, and Mr Kamal Nath.

Many of our colleagues at Tata Energy Research Institute played crucial roles in the conduct of the seminar, and the preparation of this volume. They include the rapporteurs of the various sessions, the TERI protocol staff, and Mr. Yateendra Joshi and Ms. Beena Menon of the Publications Unit. The secretarial service of Ms. Meenakumari is also gratefully acknowledged. Finally, we are grateful to Dr R K Pachauri, Director of TERI, for his counsel, guidance, and interventions. Without his active support, the initiative could not have succeeded.

Compact on sustainable development concerns in the Asian Region (October 1992)

We, the undersigned individuals from different countries of Asia, having studied the outcome of the UNCED process, and being deeply interested in and concerned about the prospects for equitable and sustainable development, place the following for the serious consideration of fellow Asians and citizens of the world

We reaffirm the right of all nations and peoples to development, both in terms of the right to freely determine their economic, social, political and cultural priorities and in terms of their right to the sustainable use of their natural and other resources.

The process of sustainable development should take into account the needs of present and future generations and the disparities between nations. Global resources must be fairly shared between nations, and conserved for future generations, without neglect of history.

International environmental policy and decision making needs to be democratized, with all involved international organizations becoming open, transparent and democratic bodies. The restructuring of these organizations should be based on the principle of the sovereign equality of nations.

The rights of indigenous communities over the resources that they have husbanded over generations and on which they have been traditionally dependent must be recognized by the world community and their role in furthering sustainable development must be acknowledged and encouraged. This is particularly important in the context of the conservation and utilization of biological diversity.

We call upon the international community to invest the requisite resources and commitment into the development and adoption of innovative international instruments to monitor and regulate the global environment, which at the same time, are capable of embodying equity concerns and financial transfers.

Climate change Convention

We urge nations to consider on an urgent footing measures for adaptation to impacts of climate change. Developing countries are particularly vulnerable and will need significant transfers of resources, technology, and capacity in order to formulate and implement necessary response strategies.

We urge nations to consider, without unnecessary delay, the development of protocols relating to various substantive issues in the Convention, including but not limited to: targets for emissions reductions by developed countries, the method of determination of 'agreed full incremental costs', the mechanisms for the transfer and development of the necessary technology, and institutional arrangements for implementation, monitoring and enforcement of the Convention and Protocols.

We are particularly concerned about the present lack of specific and appropriate emissions reduction paths for the developed countries. These should be based on a broadly agreed equity determination that takes into account historical emissions.

Appropriate measures should be taken to protect the interests of Asian, especially developing countries which are producers of fossil fuels, and products dependent on own resources of such fuels.

We note that the UNCED process has recognized the 'polluter pays' principle and we urge its adoption through an appropriate protocol, employing flexible international instruments capable of embodying equity concerns and associated resource transfers.

Developing countries have a responsibility for adopting abatement strategies in the future.

Biological diversity Convention

Adequate safeguards are required to ensure that the terms of access to genetic materials are fair to the country of origin of the resources. There is also a need to harmonize existing intellectual property rights regimes in all countries with the spirit of the provisions of the Convention that relate to the granting of access to genetic material and transfer of the resulting technology. This will considerably strengthen incentives for all countries to conserve biodiversity. The full incremental costs of biodiversity conservation must be reckoned to include credible opportunity costs.

The governments of the region should consider the formation of Asian Gene Banks and the utilization of biodiversity for the benefit and well being of their people and humanity at large, with the rights of the contributing countries over their contributions clearly defined. This would facilitate capacity building and cooperation in the region.

Population

There is a need to focus on population issues that may adversely impact environment and development but this should not be the exclusive focus. Unsustainable patterns of production and consumption, including those that are emerging, also need to be addressed without delay in this context.

Steps need to be taken to promote appropriate demographic policies in all countries with a focus on building human capital for sustainable development. Human beings have the right to primary health care, maternal and infant care, education, both primary and vocational or technical, a secure means of livelihood, clean air and water, and adequate sanitation. Asian countries must accord priority to these goals, and cooperate, in particular in capacity building for this endeavour.

Measures specifically addressing population issues need to be sensitive to local culture and value systems.

Energy

We recognize that energy production and use in the whole region, especially in developing countries, will increase in the foreseeable future, in the course of their pursuit of sustainable development.

We recognize that several strategies may be devised with respect to energy which will bring global environmental benefits, as well as lead to substantial economic savings. Governments in the region are encouraged to follow this approach.

As part of such strategies, we encourage, in particular, the following:

- *Increased utilization of natural gas.*
- *The increased use of economic renewable energy technologies such as solar, wind, biomass, geothermal, and hydel, making certain that any adverse environmental impacts and displacement of persons is minimized.*

Note must be taken of the requirements of countries in the region that are dependent on fossil fuels. In particular, their future growth paths of energy production and use would need to use fossil fuels with greatly enhanced efficiency, and developed countries both within the region and outside can facilitate this transition through mutually beneficial cooperation.

Further, energy planning and policy making within countries must fully integrate sustainability, economic efficiency, and equity concerns.

Agriculture

Agriculture and livelihoods based on land provide sustenance and basic human needs to the majority of people in Asia. We note that the UNCED process has not paid sufficient attention to this fact. The crucial resources on which such activities are based: soil, water and forest cover, must as a priority be conserved and regenerated on a planned, scientific basis. The sustainable development of agriculture including by use of modern biotechnology is crucial. This endeavour provides significant opportunities for cooperation among countries of the region.

Environment-economy linkages

The international community should consider innovations to deal with foreign aid and debt repayments in the context of past and future utilization of global environmental resources.

The meaning of 'open and supportive economic system' should not dilute the content of sovereignty and concerns of self reliance of developing countries in Asia and elsewhere.

The world is likely to move to an era of freer trade. It must be ensured that trade liberalization measures enhance sustainability and resource conservation.

Agenda 21

Agenda 21 details a rich and potentially fruitful field for international cooperation in sustainable development.

Asian countries, both developing and developed, between them possess vast reservoirs of skills, knowledge, know-how, and organizational capability. This provides an important basis for cooperation within the region and outside. Such cooperation should be pursued on bilateral and multilateral basis, as well as through international organizations.

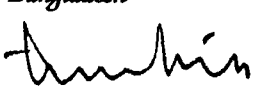
We are convinced that the conservation of the environment and development go hand in hand. We believe that Science and Technology form an essential component of the search for feasible pathways towards sustainable development.

Asian countries may, for a start, perhaps through appropriate regional organizations, undertake a detailed inventory of their collective resources for capacity

building for sustainable development. In this compilation, both governmental and non-governmental organizations need to be involved.

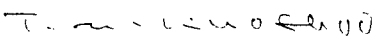
We affirm that capacity building and human resource development is at the heart of any plan to implement Agenda 21. The training of young professionals to handle the environmental problems is therefore an essential part of Agenda 21. This specific training for sustainable development has to be problem oriented. Many problems of the Asian region are common.

Bangladesh



(Fasih Uddin Mahtab)

India



(T N Khoshoo)

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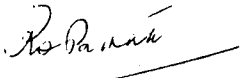

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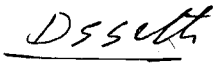

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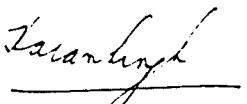

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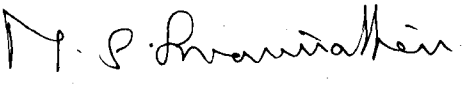


(M S Swaminathan)

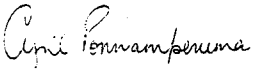
Indonesia

(Mohammad Sadli)

Jordan

(H Khatib)

Sri Lanka



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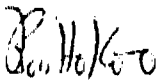
South Korea



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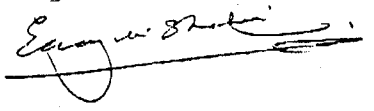

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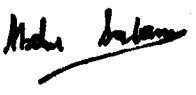

(Abdus Salam)

Philippines

(Helena Z Benitez)

RECOMMENDATIONS OF WORKING GROUP I

Implications of the Rio Agreements and the future path of negotiations on protocols and institutions

Chairperson: Fasih Uddin Mahtab
Rapporteurs: Maithili Iyer and Akshay Jaitly

Pre-conditions to further negotiations on global environment

There is a marked asymmetry between industrialized and developing countries in their respective capacities for formulating informed and cogent positions during the negotiating process. This asymmetry in capacity may have influenced the outcomes of the negotiations leading to the Rio agreements. The agreements themselves were negotiated in a relatively short period of time with the explicit objective of adoption at the UNCED in June 1992. This period was too short for building up institutional capacities in the several disciplines which are germane to formulating negotiating positions.

Domestic capacity needs to be built in the relevant policy studies, scientific disciplines and institutions, as well as in skills of public policy analysis and policy making. The process of such capacity building must commence expeditiously and involve the greatest measure of international cooperation between industrialised and developing countries on the one hand, and developing countries themselves on the other. The future course of negotiations must allow for this process to get sufficiently under way.

The initiative for such capacity building must emanate from developing countries themselves, both individually as well as through their groupings, which may be regional. The scope for cooperation between developing countries in this respect should not be underestimated. Cooperation in such capacity building should also rely on professional and scientific networks and associations in developing countries as well as industrialised countries, besides intergovernmental organizations. It is essential for the International Panel on Climate Change and the Commission on Sustainable Development to initiate specific actions for capacity building in developing countries on global environmental issues, and to ensure the utilization of these capacities in their deliberations, as also at the institutional level. The role and potential of NGOs, including several NGOs in the North with outstanding records, for assistance in both capacity building and support to negotiations is considered to be of key importance.

The Framework Convention on Climate Change

General issues

- The first priority, before any serious negotiations on future protocols or other arrangements can take place, is for countries to ratify the Convention itself without unnecessary delays.
- Strategies for mitigation and adaptation to climate change cannot be isolated from issues of poverty alleviation and from ethical issues of conspicuous consumption and excessive resource use by the developed countries.

Capacity building

- Reporting requirements under the Convention will be greatly enhanced by the development of scientific and institutional capabilities for independent assessments in developing countries themselves. This would also reflect national concerns on accuracy and appropriate consideration of scientific uncertainties in GHGs sources and sinks.
- Domestic know how is also essential to identify possible options to lower anthropogenic GHGs increases, including institutional and policy measures. Active collaboration with individual independent, scientific institutions in developed countries should be promoted.
- Differentiation should be made between different sources of emissions. One such distinction could be between 'energy' and 'subsistence' emissions of GHGs. Such differentiation should further consider the controllability of different sources of GHGs.
- Negotiations should also consider persistent scientific uncertainties especially with respect to GHGs sinks. Collaborative research, both within the region and with institutions in the developed world should be considered for this purpose.

Equity

There is an urgent need, prior to the start of the negotiations, to formulate and analyze in detail various equity principles and formulations for sharing the global commons and for burden sharing, with reference to GHGs mitigation and adaptation costs.

GHG mitigation

- The international community will have to consider measures relating to compensation for domestic steps involving high costs taken to mitigate global environmental problems.
- Financial resources are required for mitigation projects with high initial capital investments, to ensure their economic viability under desirable social discount rates.
- There must be an emphasis from developing countries not to agree on absolute emissions targets but rather on dynamic ones, for example, those relating to energy efficiency improvements.
- With their current structures, financial mechanisms such as the Global Environmental Facility are not equipped to institute decentralised decision making to put into place measures for energy efficiency, technology development and other actions, which may require decisions by a large number of individual actors.

Adaptation strategies

- Special steps should also be initiated for global assessment of the problems relating to measures of adaptation to climate change. Such analysis should focus in particular on the agricultural sector and the protection of low lying coastal areas.

The Biodiversity Convention

- The protection of biodiversity is of particular importance to ensure meeting basic needs. This is of special importance for improving agriculture and increasing its resilience to adverse impacts, including those of climate change.
- Capacity building is important for developing countries to determine the value of potential biological resources and, further, for making use of these resources to meet their development needs.
- To overcome the lack of information that exists relating to the extent and value of genetic resources, it is necessary to develop biodiversity inventories, preferably on a cooperative and regional basis.
- Capacity building is also necessary with respect to the development of biotechnology, especially that which relates to agriculture and food production.
- Institutional development and evaluation and monitoring of biological resources within developing countries is also essential; this will require additional capacity building measures.
- Attention needs to be paid to developing adaptation strategies to deal with the loss of biological diversity. Again, agriculture is a priority area. Technology transfer, particularly in the area of biotechnology, has to encompass comprehensive adaptation policies which address the issues of adaptation, modification and indigenous development of these technologies and techniques.

RECOMMENDATIONS OF WORKING GROUP II

Formulation of national/regional strategies in pursuance of the Rio Agreements including Agenda 21

Chairperson: Ikthiyar Omar
Rapporteurs: Neha Khanna and Anna Roy

Background

As is well known, different countries in this region are in widely varying situations.

- Diverse geographical features. There are countries such as the Maldives Islands that face immediate dangers from the impacts of Climate Change such as sea-level rise, and others like Bhutan with fragile mountain ecosystems.

Technological development

- They are at different stages of technological development, especially in terms of the endogenous capacity base.

Resources utilisation

- Although most of the countries in this region are fossil fuel based with a large share of biomass, there are substantial differences in the resource utilisation.

Economic growth and development

- Last, but not the least, they are at different stages of economic growth and development.

Thus, while the national strategies of these countries would be built around the underlying theme of sustainable development in the light of the UNCED process, they are likely to differ substantially. It is however possible to identify important common elements that would be central to the strategies of the countries in the region.

Basic elements of a national strategy

- Increased utilisation efficiency of the different energy resources both in industry and power sectors.
- Switch to alternative and new energy sources such as solar, hydro and wind as appropriate.
- Increased carbon sequestration through afforestation.
- Efficient waste management including recycling of waste. Special attention to management of hazardous wastes will be essential.
- Controlling and stabilizing population growth rates through immediate measures and sustained growth policies is another crucial element in the national strategies of the countries of the region.
- The countries face a huge population pressure on their resource base (perhaps the only exception in this regard in South Asia is Bhutan).
- Creation of strong endogenous environmental technologies.

Policy issues

These basic elements will have to be fully complemented and supported by a number of other measures, primarily in the policy arena, to provide the necessary incentives to the concerned economic agents. Some of these measures are listed below:

- As a first step, countries will need to introduce effective legislation for the protection and enhancement of the environment. In countries where such legislation already exists, there is a need to redefine it and make it more comprehensive and supportive of resource conservation as well as development. Monitoring is also an important aspect in this connection.
- Resources balance sheets, as dynamic assessments of stocks, flows and potentials for key resources should be constructed to serve as bases for both environment and development management.
- EIA (Environmental Impact Assessments) should be made a preliminary requirement. At the same time they must become development sensitive and more integrated with economic (social) cost-benefit analysis. Comprehensive Environmental Auditing, especially in the industrial sector, should be carried out in each country. In many countries, it is possible that the requisite knowledge with respect to these is not available. Thus steps should be taken to build up the knowledge base in these countries.
- Appropriate policies to facilitate technology transfer are required -- both in the domestic economy and in the international arena. These should include extensive screening of all available technology at the international level so as to weed out the inappropriate technologies. In this respect, special mention should be made about the steps taken by various government bodies to ensure that 'dirty technologies' are not imported. In the same vein, appropriate steps are required to encourage increased research and development in the adaptation and adoption of new technologies to the recipient economies.
- Extensive research is also required in identifying the areas in which traditional and indigenous technology could be applied, most of which may not be known to the West. The use of these technologies should be encouraged, so as to complement others that may be in place.
- National strategies should also give due attention to environmental education at all levels.
- Research institutions both in government and non-governmental sectors need to be encouraged so as to provide adequate research backing to governments. A continuous feedback from these research projects should be institutionalized so as to facilitate policy making at the national level.
- Local environmental organisations will need to be strengthened to maintain pressure on governments to incorporate environmental considerations in development programmes.
- Carbon sequestration through afforestation should be a major element in national strategies. In this regard, both social and compensatory forestry programmes should be encouraged. However, to make this policy effective, appropriate forest management programmes will be required.
- An important element needed in the formulation and implementation of national strategy is political will.
- These different common elements of national strategies, together with others which are specific to each country, need to be combined into the national Agenda 21 action plans.

Initiatives taken

Some countries have begun to take the first few steps in this direction. For example, in Bhutan, sustainable development seems to be the core element in the overall development process. It is noteworthy that about 60% of the land area of Bhutan is under forest cover and 20% (of the total land area) is declared as protected area. A strict family planning programme has succeeded in restricting the population to only 600,000 in a total area of 47,000 sq. km. Recently BTF (Bhutan Trust Fund) was set up with the total funding of 12 million dollars (of which 10 million dollars was provided by the Global Environmental Facility of the World Bank), to facilitate environmental conservation.

In Thailand, the Government has been laying increased emphasis on the incorporation of environmental considerations in development planning. Recently, the Ministry of Science, Technology and Environment was restructured with the mandate of policy planning with respect to environmental considerations and control of toxic wastes.

In the Maldives, the biggest environmental threat is from sea-level rise. Some policies were formulated in anticipation of Rio, which are currently being strengthened. For example, recently a policy of licensing for coral mining was introduced so as to decrease the pressure on coral reefs, which form a natural barrier against sea-level rise. In the 202 inhabited islands of Maldives, all communications are based on solar power.

These national strategies could be facilitated by increased South-South cooperation. Existing regional cooperation organisations should be supported. However, to make these organisations more effective, the mandate should be clear and made more specific.

RECOMMENDATIONS OF WORKING GROUP III

Scope for regional cooperation and capacity building for sustainable development

Chairperson: Saswinadi Sasmojo
Rapporteurs: Mala Damodoran and Sanjay Mohanty

Questions addressed by the Working Group

- How has regional cooperation taken place in the past, and what are factors which could help improve regional cooperation in achieving development options that are more sustainable in the Asian region?
- What are the important areas for regional cooperation to achieve sustainable development?
- What are the possible avenues to promote regional cooperation for promoting sustainable development?

Regional cooperation

The Working Group observed that there are several institutions/organisations in the region that aid in regional cooperation. These comprise UN organisations, intergovernmental organisations and non-government institutions. Some of the multilateral institutions are ESCAP (Economic ans Social Commission for Asia and Pacific), SAARC (South Asian Association for Regional Cooperation), SACEP, ASEAN (Association of South-East Asian Nations), SPREP, APTC. Examples of non-governmental institutions are ADB (Asian Development Bank), AEI (Asian Energy Institute), AIT (Asian Institute of Technology). The regional institutes have the capacity to influence the decision making process as well as operationalising concepts like sustainable development. The Working Group felt that the following would enhance regional cooperation in achieving sustainable development.

- Creating a climate of inter-regional political reconciliation to agree on certain common issues of concern.
- Identifying issues of common concern.
- Enriching the information base so as to strengthen the decision making process; thereby developing a better understanding of sustainable development and environmental problems.

Important areas for regional cooperation and capacity building

- Optimal utilisation of natural resources on a regional basis (e.g., trade in the power-sector between Nepal and India, thereby substituting coal by hydel power, thereby reducing pollution in Nepal caused by coal utilisation in India).
- Enhancement of technology capability and capacity.
- Improving the quality of information generation within the region.
- Developing methodologies to incorporate environmental considerations in development processes/activities. This would include attempting to impute a price for environmental resources. While price might not fully reflect all aspects of resource use and environmental degradation, it could serve as a strong signal of the extent of possible damage.
- Incorporating resource accounting into the national accounting framework. This would require modifying existing accounting methodologies so as to arrive at a

common base for all countries. The ongoing work within the UN, on this subject is noted as a significant contribution to this process.

Developing the capacity of the individual through a bottom-up approach. This would require disseminating information with regard to the potential benefits, as well as training individuals in mobilising support and generating awareness of the grassroots level.

Advantages of regional cooperation

(i) At the intergovernment level — this requires clarification of the issues on which cooperation could result.

(ii) At the governmental level — this would require a robust and lucid information package.

(iii) At the institutional level — this would require an action plan for operationalising the programme and for information dissemination on a time bound basis.

(iv) At the people's level — this involves awareness creation and basic training, and finally,

(v) At all levels — women should be integrated into the processes and structures of decision making.

Inaugural session: inaugural address

Hon'ble Shri K C Pant
Chairman, 10th Finance Commission

I have great pleasure in sharing some thoughts with such a distinguished gathering of thinkers, policy makers and representatives of international organisations. This meeting, I find, will examine follow-up action to be taken on the issues thrown-up by UNCED (United Nations Conference on Environment & Development) at Rio. I have watched with great interest the preparations for the Rio conference as well as its outcome. In fact, I recall that in December last year when Mr Maurice Strong, Secretary General of UNCED was in New Delhi, TERI had organised a meeting of a select group of persons which I had the pleasure of presiding over. I found the interaction stimulating and productive.

Now that the UNCED is over, the time has come for the global community as a whole, and for the countries of Asia in particular, to evolve an agenda following up on the UNCED. But this is perhaps a good stage for us to evaluate what was achieved at Rio and what did not receive the attention that was due. My own assessment is that the Rio Conference should have addressed issues of poverty and development far more effectively than it actually did. From the point of view of the South, therefore, Rio has not quite lived upto the expectations that had been generated. Undoubtedly, in the months intervening since the conference several governments and non-government organisations have had time to make a sketch of the road ahead, often referred to as the *'Road from Rio'*, and I see several reasons why these deliberations and consultations are both urgent and significant for the future health of this planet and all life that exists on it. I would like to enumerate some of the major tasks and challenges that I think need to be discussed and pursued in this seminar, and these are briefly summarised below :

1. The Rio agreements have set up a framework for policy making and action for integrating environmental concerns with development at global, national, state and local levels. However, this framework needs to be given substance.
2. In the post Rio phase, we are immediately confronted by the fact that several, protocols need to be negotiated, the institutional framework for international cooperation and transfers of resources and technology has to be established, and developed countries must begin committing funds for sustainable development.
3. At the national, state, and local levels, policy making and planning must be reoriented to integrate environmental concerns with development. This will require legal and administrative action, but more important, the building up of capacity; skills, technology, and a reorientation of policy making is essential, and the last is absolutely crucial.
4. In particular, the challenge is to ensure that sustainability concerns do not lead to a new generation of discretionary controls on economic activity. Further, it must be realised that policy making is to be effectively formulated in a manner that is revenue oriented, or even revenue surplus, to address environmental concerns. In this the developed countries must take the lead to solve the environmental problems of the globe—problems which have largely been created by them.

and in their patterns of expenditure and taxation to ensure adequate resource transfers to the developing countries.

I would not like to exclude the responsibilities of the developing countries for protecting the global environment. In many cases there is a distinct overlap between policies and actions that protect the global environment, and those that sustain the natural resource base at the local level. This can happen only if we are able to integrate environmental concerns into development plans. As a start, it is essential to build into our national income accounts the effects that economic activities have on the wealth of natural resources for which a society is responsible, such as effects on forests and soil. The building of local capacity for integrating environmental factors into development decision making is crucial to the success of any effort in this field. Capacity building has to become an essential part of each government's plans at the national level as well as in the programmes that international organisations are pursuing and implementing in different countries.

There is a fear, perhaps genuine, that environmental concerns would lead to a new regime of controls and licensing, which would retard economic development and progress. We have to be very careful about avoiding such an approach. Governments and Bureaucracies often find it convenient and easy to build in controls and constraints that only add to the cost of development plans and activities. Environmental aspects have to be built into plans at the stage of project design and identification itself, and not imposed as an end-of-pipe addition. In other words pre-emption and prevention are generally less expensive than mitigation and control. We would have to therefore, change the way we govern and do business to ensure a healthy and sustainable approach to development questions.

A meeting like this also gives us opportunity to explore the potential benefits of South-South cooperation. South Asia could be surplus in foodgrain production if only we exercised wisdom in the management of water, much of which we share with each other. Environmental phenomena in the mountain areas of our sub-continent have impacts on all nations and states downstream. A regional approach, therefore, has obvious merit.

Finally, what we are addressing in this Seminar is the challenge of transition to a pattern of sustainable development. The term sustainable development came into our vocabulary because of the work of the World Commission on Environment and Development, popularly known as the Brundtland Commission. The definition of the term is 'meeting the needs of the present generation without compromising the needs of future generations'. I should end by reminding this international gathering that sustainable development implies primarily meeting the needs of all in the present generation, because those who are poor and deprived would neither have the means nor the ability to protect the interests of future generations. Sustainable development, therefore, essentially requires that we create the means for the poor of this world not only to service their own needs but also of those yet to come in the future.

I have great pleasure in inaugurating this Seminar.

Inaugural session: presidential address

Mr R S Pathak
(Former) Chief Justice of India

Dr Pachauri, Mr Dessau, Mr Pant, Mr Khalim, Dr Ghosh distinguished participants in the seminar, ladies and gentlemen.

This seminar holds a significant place in the deliberations which can be expected to follow the UNCED (United Nations Conference on Environment and Development) held recently in Rio de Janerio. The Rio Declaration seeks to accommodate the conflicting claims of industrialized societies and developing nations and the emphasis on environmental protection is balanced against the need for development. The concept of sustainable development, which is not specifically defined in the Declaration, may be approached from different perspectives and value judgements in different situations and will turn on an assessment of the particular developmental, financial and economic status of the nation as influenced by prevailing social and traditional cultures. The concept of sustainable development is a dynamic concept and with an accretion of data, knowledge and experience in the different dimensions of the environment–development equation, it can be expected that the concept will attain further range and depth to meet the challenges of new demands, recognizing the all embracing dimensions of environmental and developmental imperatives. The Rio Declaration covers a wide spectrum of related policy concerns. With human beings as the focus of sustainable development, the Declaration attempts to create a harmonious and equilibrated world society in which, commencing from the eradication of poverty as the fundamental impulse, carefully drawn principles define rights and responsibilities in the connected areas of patterns of production and consumption, of population control, of bio;domg indigenous capacity through the benefits of scientific and technological knowledge and the evolution of an appropriate equitable international economic system. In its totality the Rio Declaration accepts and affirms the unity which binds all these concerns and it takes into account the interacting influences on one other. Each strand of that network depends for its strengths, its resilience, and its effect upon the operation and efficiency of the rest of the network. International lawyers will recognise that a new legal philosophy incorporating a more - compendious range of values has been developing in recent years. With the establishment of the UN and the growth of international institutions and their ubiquitous presence in almost every dimension of individual daily life, a complex system of jurisprudence is taking shape. Among other post–World War II phenomena, environmental–imperatives and developmental concerns have drawn international law into intimate convergence with national legal systems.

The values of one flow into the other. This symbiotic relationship has exercised a profound influence on both legal systems. Sustainable development cannot be conceived without national laws being interpreted in a manner consistent with corresponding international law values and when an international law develops in an area, it needs to take into account the diverse economic and social cultures of the nations concerned. With new movements affecting international life such as never been envisioned before, both international law and national legal systems are moving on to a new chapter of development. Some indications of this are already embodied in the Rio Declaration, for we find reference to the need to amplify and flush out the concept of

sustainable development, including specific emphasis on intergenerational and intragenerational equity, access to information procedures and legislation incorporating relevant environmental standards and management objectives and priorities.

Enforcement and monitoring institutions constitute an important feature of the legal structure. One international institution which needs to be thought of sooner rather than later is a dispute settlement mechanism to adjudicate on transboundary disputes arising out of environmental claims by individuals or private organisations. Some eminent jurists believe that the International Court of Justice is inadequate for that purpose in terms of its present statute. For in transboundary matters it can entertain disputes only between one state and another and that also by voluntary agreement of each party. There is no one forum today enjoying compulsory jurisdiction over environmental disputes to which an individual or a private organisation may apply directly.

If there is one truth that emerges from the successive phases of the environmental movement, it is that the issues that faces today are issues which will ultimately determine the fate of mankind on this planet. The health and welfare and indeed the survival of the human race is at stake. It is equally true if that threat is to be conquered it can only be on the basis of global partnership where the national units of the global community act as equal partners in combating environmental problems. The development of underdeveloped nations therefore becomes a matter of significant importance and in that context the quest for equity and justice assumes the highest relevance. While maintaining their sovereign right to utilize their resources in the freedom of the priorities determined by them, the developing countries must be assisted in raising their levels of development by financial transfers and the supply of clean technology by industrialized countries on fair and equitable terms. In doing so, the industrialized countries will be guaranteeing their own security as well. Thus justice, equity and fair play become the key words for the present task of restructuring the world community on the basis of sustainable development.

This Seminar is primarily intended for an examination of environmental and developmental issues affecting Asia. The Asian continent is often perceived as a developing region, but we must not forget that it is also the home of a few highly industrialized societies. This has relevance, for in the world of the immediate present regional proximity can play a material role in the development of national economies. And yet there is another aspect to which reference may be made; regional economic communities are now well known, notwithstanding their traumatic journey to maturation. As sustainable development wears the grim face of environmental and economic values, regional economic activities will necessarily take up environmental considerations. And there is a lesson in this. For such a regional system based on the necessity of cooperation, mutual assistance can become an important factor in reducing political tension between neighbouring countries. It may truly be said that environment and development concerns have set in motion forces that can usefully be harmonised in the common interest of environmental protection, of development and of peace and prosperity.

Thank you.

Valedictory session: valedictory address

Hon'ble Shri Manmohan Singh
Finance Minister, Government of India

Thank you Dr Pachauri, Shri Kamal Nath Ji, Professor Cyril Poonemperuma, Ladies and Gentlemen,

I think someone described public office as an opportunity for private education at public cost. I must confess to you that I have no expert knowledge of the subjects which you have been discussing. But in the course of my work as Finance Minister, sometimes I have to browse through voluminous papers that the Ministry of Environment and Forests produces. I think some of it rubs on to me, and therefore please treat what I am going to say as a layman's view of the environmental dimension of managing the global inter-dependence.

We live in a highly uncertain world. As Sir Harold Wilson, the former British Prime Minister, once said, 'A week in politics is a very long period of time'. Finance Ministers are notoriously pre-occupied with day to day management, and it is quite possible that longer term issues of vital importance to the future of our country, and to the future of the globe, often escape their attention. I, therefore, welcome this opportunity to learn more about environmental matters, if for no other reasons than, as the poet P.B. Shelly once said,'the desire of the moth for the star, of the night for tomorrow, the devotion to something afar from the spheres of our sorrows', It, for a moment, takes me away from the impossible task of managing the finances that most Finance Ministers have to grapple with, howsoever imperfectly.

Having said that I think, one has to recognize that countries of the third world have a vital stake in the protection of the global environment, in ensuring that the vital life-support systems of our planet are managed, used and conserved in a sustainable fashion, and that issues both of intra-generational equity, as well as inter-generational equity, are in the forefront of thinking about the environment. Indeed, that is as it should be. After all, the world has a single environment to share. Three-fourths of humanity lives in the countries of the third world, and although it is not very fashionable to use the term 'third world', the second world having disappeared, the fact is that the great majority of people live in the countries of the South or the developing world. If irreparable damage is done to the environment, whether by way of climate change of an irreversible nature or whether by way of depletion of the ozone layer, we will also suffer, and being a majority of humankind we will probably suffer more than others. Therefore, this new thinking, that environmental issues are not issues of North-South confrontation, that we have to deal with the problem of environmental management in a spirit of cooperation and not in a spirit of confrontation, this is something which we readily accept. That has been our approach as a country and as a government, in dealing with these problems, the issues that figured at Rio, i.e., the Rio Declaration on Environment and Development, the Agenda 21 Action Programme and the Statement of Principles on Forests.

Although all these are non-binding obligations, they do set out a framework consisting of principles and also an action programme. I noted that Agenda 21 has roughly about 100 programmes in different areas of human activity. So, there is lot of food for thought in all that. In addition, we have the two conventions which were agreed to earlier, but signed at Rio: the Convention on Biodiversity and the Framework

Convention on Climate Change. At the intellectual plane, they do advance our knowledge of the harm that human beings can do to the environment, that thoughtless pre-occupation with modernization can at times become highly unproductive.

One favourable fallout of this UN conference has been the explicit recognition that any programme on Environmental Protection must accept that as far as the poor countries of the world are concerned, poverty eradication and development have to occupy centre-stage. It has also been accepted that it is the sovereign right of these countries to exploit their own resources. But out of this, there is also a danger that a body of case law might be built, if developing countries are not careful in which concern with the environment, howsoever desirable, howsoever welcome, might degenerate into a new sort of imperialism, a new sort of colonialism. I say so, not to frighten our people. As citizens of the world, it is our duty and obligation to cooperate with the rest of the world to find acceptable, equitable solutions to the management of this growing global inter-dependence. But, one must recognize, as I stated some weeks ago in Washington in a different context, that UN Conferences are important, but it is no use abstracting from the fact that the world is not a morality play in international relations. After all that is written in the UN documents. These relations are essentially power relations. Therefore, if you recognize that fact, there is always a danger that if you are not careful, seemingly innocuous principles can become fetters on further progress. For example, take the case of the recognition of the sovereign right to exploit one's own resources. But, as I read the Rio declaration it also says that activities within the jurisdiction of a country must not cause damage to the environment of areas beyond the limits of their national jurisdiction. This is unexceptionable. However, cross-border externalities are a fact of life, not only in environment management, but in other activities. Who is going to decide whether damage has been caused? When national policies of developing countries impinge on others or result in cross border externalities, the same Rio Declaration says that environmental measures that deal with transboundary or global problems should as far as possible be based on international consensus. I think, this too is unexceptionable. But in a world of unequal bargaining power, in a world of unequal power structures, there is a danger that if developing countries are not alert, this could become a mechanism for imposing thought processes, production structures and other related aspects, which may do irreparable damage to the process of sustainable development in poor countries of the world.

I am saying all this not to frighten our people, but to ensure that our research workers, our policy makers, are sufficiently alert that when it comes to negotiating the follow-up to the Rio Declaration or Agenda 21, or Statement of Principles on Forests, that the equitable and balanced management of global inter-dependence is lost sight of. But this cannot be ensured merely by repeating first principles. I have been associated with various negotations in UNCTAD. Today, environment is the fashion. In the sixties trade was the fashion. So, there was the first UN Conference on Trade and Development. Great expectations were aroused. Every four years there has been a conference on trade and development. But I do not think, frankly speaking, we have advanced very much in changing international trading structures. The principles enshrined in the first session of UNCTAD, as I read them today, I think are honoured more in the breach than in acceptance. I sincerely hope that this is not going to happen to the Rio Declaration, but that is a danger which can be warded against only if developing countries do their homework carefully, provided our research agenda throws up genuine problems, provided there is a proper costing of trade-offs. There is no

reason why this can not be done, with so much intellectual manpower or womanpower that exists in the third world. All the estimates of damage to the environment may have to go back, to quote the Washington based World Watch Institute and, therefore, all the time we are reacting to what is said or what is written, and since it is a gathering of research workers, I venture to say that intellectual colonialism is far more dangerous than the colonialism of the traditional type. The mind set has to be liberated. But, unfortunately in all these matters again power relations do come in. If our intellectuals want to make a mark, they must be quoted in the footnotes written by some great experts in the first world, and it is the first world scholars who really determine what is good scholarship, what is good science, what is good economics. Therefore, that way, the whole agenda of scientific research, the whole agenda of social research, the whole agenda of technological research, can be easily distorted. One cannot wish away this global interdependence, one must not draw into a cockpit of one's own, but we must, I think, develop in our societies, in our research institutions, capacity for independent thinking, capacity to look at our problems in their own setting, and with a mind-set which is in tune with the realities that prevail in the countries of the third world. Otherwise, there is a very considerable danger that noble principles could become another millstone around the necks of the countries of the third world.

The same way, if you look at the Agenda 21 Programme, there is large-scale collation of principles and follow-up programmes of action, and I notice more than 100 programme areas covering social and economic dimensions of sustainable development, conservation and management of resources for development, strengthening the role of major groups, the means of implementation, all very valuable areas. In particular, if you look at the section on conservation and management of resources for development, various items are listed. They all are very worth-while areas, in which unless the countries of the third world throw up their own solutions, our development will be slowed down, and in this process our bargaining power in dealing with the countries of the North will also be damaged beyond repair.

Therefore, the message that I do want to give to this distinguished group is: you have all these issues stated, but let us look at these issues with a liberated mind-set. The second thing that I do wish to say is that it is, indeed, good that the Rio Declaration accepts that poverty removal has to be an integral part of a policy of sustainable development. The chapter on poverty in the Action Programme addresses these issues of eradication of poverty, removal of hunger, and the management of natural resources in a sustainable manner. But it is necessary to translate all this into credible strategies of sustainable livelihood. And here, I feel, there is a need for a very fruitful inter-disciplinary research, in which scholars of Asia can contribute a great deal. As Kamal Nath Ji has said, our development cannot be a carbon copy of the development path and lifestyle pursued elsewhere in the world. If we pursue those paths, I think you would have a very small minority of our people living in affluence, the great majority being condemned to abject poverty. The concomitant of that would be massive social upheaval, social unrest, political and economic uncertainties and chaos. Therefore, that clearly is not a sutainable means.

At the same time, one has to accept the reality that what is happening at the global level is also happening in our own countries. We say one thing, we do another. In our own societies, therefore, this gap between the affluent minority and the vast number of people is growing—one life style for a small minority of people, another life style for a great majority of our people. And we have reduced through television the

mass of our people marching on the course of this process of modernization. Most of them probably will never have a chance to own all this sophisticated gadgetry which is shown on television. We are, therefore, creating a society of looking through the glass, with the aspiration that one day the life would become better, which would engulf our societies. Therefore, there is need for new thinking about sustainable livelihood patterns, sustainable livelihood in the area of rural development. Evolving technologies which will raise the productivity of large farmers, but are also equally accessible to the small farmers and the marginal farmers. Sustainable patterns of human settlements which would ensure that most people can aspire within their lifetimes to have access to shelter of which any civilized society can be reasonably proud of. Therefore, building technologies, the whole thinking about how to ensure that these houses provide reasonable comforts without all these sophisticated gadgetry of the post-industrial societies are challenges which have to be faced.

Some years ago, in this country, we had a distinguished group of citizens of our country under Charles Correa who produced a very impressive report on the urban chaos that awaits India. It is gathering dust. There has been very little intelligent discussion of this tremendous problem that faces India in the next decade, and I am sure that what is going to happen to India is going to be true of many other countries of the third world. The way most cities in the third world are growing, the divide between a very small affluent class and a great majority of the people, is widening, and you will have, if this process persists, only very rich and very poor people living in our cities. Very rich because they can afford it, also because they have access to the coercive agencies of the state and in countries like Philippines they can engage also private protection forces, and the very poor who do not mind sleeping on the pavements. So in this whole area of human settlements, an area which is listed in the Rio Declaration, there is need for a lot of intellectual effort to think about viable strategies which would bring about a certain amount of equality in access to basic goods, the quest for affordable technologies. Unless we do that, I think, the process of growing inequalilties in consumption and patterns of living is going to overtake us all with all the disturbing consequences that it is likely to bring in its frame.

Similarly, I was reading the chapter on protecting and promoting human healthcare. I think, there are very valuable concerns in this Rio Declaration, and yet we all know, that the way our societies are growing, this will remain a pious wish of having western oriented hospital centered medical systems that the countries of the third world have followed. It has no chance of ensuring that decent health care will become ever accessible to the great majority of the people in India, or in other parts of the third world. Even countries like United Kingdom, countries like United States, today find that the hospital bills and the medical bills are rising at such a fantastic rate that they are throwing up their hands, and their fiscal systems are not able to cope with these problems. Therefore, here is another fruitful agenda for thought. May be we ought to shift this emphasis from a hospital-centered curative approach to medical services to greater emphasis on preventive measures. But in our country, I find in our medical colleges, we look at what are the prestigious areas of work; no professor likes to work on public health engineering. Therefore, the result is that a wrong sided development is taking place. We satisfy our conscience by writing plan documents, every plan document mentions access to health care and universalization of education. Plan after plan we note our failures to achieve them. We feel satisfied that we have done our duty, we have recognized our defects. But, this thing cannot go on. In all this, there is a

certain element of hypocrisy where the ruling classes in all developing countries say the right things, but when it comes to doing the right things, the means are not provided, the agenda for research is distorted and the priorities of allocating resources are distorted.

Nobody would talk of giving the disenfrenchized people of our country the same amount of voice. This year, for example, the Government of India was short of resources. We cut some funds for the Universities. There was a very loud protest, may be rightly so. But the fact is that year after year, primary schools in several parts of our country do not have blackboards, do not have teachers. Now, that does not arouse the same amount of protest. It is because the people who control the media, people who control the processes of Government, civil servants, politicians, they all come from a background in which the needs and aspirations of the disinfrenchized majority of our people do not get adequate recognition. I think we have to change this if we really take sustainable livelihood as a serious proposition, and not merely as a passing fad.

I, therefore, feel the countries of the third world have to do a lot of homework. Quite honestly, whatever the developed countries may say, it would be utterly wrong on the developing countries to assume that for these tasks they are going to get money on a large scale from the developed countries of the world. That will be simply self-deception. After all what is it that the developed countries have committed themselves to? They said they will endeavour to provide 0.7 per cent of their national income as concessional developmental finance. This was the commitment made in the year 1961. There is a famous General Assembly Resolution, and the world has not changed. It is 'endeavour', there is no commitment. The richest country among the developed countries, the United States, simply disowns all this altogether. The average today is lower than it was in 1961 in terms of the percentage. Therefore, I think we cannot really depend upon the first world to find solutions to these problems. We should welcome the spirit of human solidarity. If help comes, we should welcome it. It is our duty that when help comes it must be properly used. Since concessional resources are scarce, it is our obligation to ensure that they are used to promote genuine development, helping the poorest sections of our society, but do not count on that like Manna, there is going to be a providential gift which is going to provide resources for dealing with the problems of sustainable development in the third world.

The secretariat of the UNCED, I am told, did study that if you have to carry out this Agenda 21, then on an annual basis you need about $600 hundred billion, and of that $125 billion must come from the developed world. Well, the first test is going to come in a few months. The next replenishment of IDA is to be negotiated. The last 9th replenishment was roughly about $15.5 billion and if you want even to maintain the real size of IDA, I think you need roughly about $17.5 billion. There has been a talk of an 'earth increment' of $5 billion and even of that they say that $1.5 billion would come from the interest income of the World Bank. So, we will test it. From my soundings, quite honestly, concessional money is going to become more scarce then ever before, and therefore, do not build castles in the air.

If sustainable development is in our interest, and it is in our interest, we must build these concerns into our development processes, environment impact analysis must become an integral part of our development process, and in the same way the national accounts of our country must be amended to take account of the damage that various economic policies do to the environment. In fact, if you do proper environmental accounting and if it is built into the processes of national accounting, what appears as

output would simply be appearing on input side, and this is another area where I feel there is need for greater understanding, greater co-operation among countries of the third world, to build a new consensus as to how environment impact analysis and environmental accounting can be built into the whole system of national accounts. Similarly, when you come to areas like Biodiversity, now, of course the two conventions are a compromise and depending upon who is your audience, you can always point out what we have achieved. As far as the United States is concerned, I think, they ought to be congratulated for their being more honest, had they felt that this convention is inconsistent with their conception of what should be the role of intellectual property rights. Many European countries and others feel the same way, but they feel it is polite, after all we are writing only a few words. Therefore, let us buy peace. When it comes to negotiating in GATT on intellectuals property rights, we will see what happens there.

Therefore the challenge: how are we going to ensure this solemn affirmation to this biodiversity convention, that the intellectual property rights system that will emerge from GATT is consistent with it. There is lot of research work that needs to be done in this country. Quite honestly, I was ashamed when Mrs. Calra Hills came here and she was talking to me. Contrary to the image that people have that she is a very harsh, very tough lady. I found her very receptive and she said, 'I would like to get from you an authoritative document about what is the impact on India if you accept the US proposals on intellectual property rights'. And she told me their people have done their homework. They find that 95 per cent of the Indian pharmaceutical products are off-patent any way, and she said that it was her honest conviction that the cost to India is going to be minimal. Yet in vain, I look for an Indian study which would tell me what exactly would be the cost to India if we did accept the intellectual property regime which is being talked about by the United States under Super 301, or the cost of the intellectual property regime which is implicit in the Dunkel draft. I am saying that there is need for lot more intensive intellectual work, so that whenever negotiators go into these forums we are better equipped, we are better informed. This is also a fault of our negotiators because the world of knowledge and the world of administration, often function in compartments. The challenge of our times is, since knowledge is becoming more and more an important influence on policy making, how to break the walls between these two cultures in the famous words of the late C P Snow.

In some areas of Biotechnology, the convention on Biodiversity does mention that countries which have genetic resources have to be consulted, that they have to be active participants in the research work and in sharing the benefits that come out of that research from the use of those genetic resources. I have read somewhere that although this figure is uncertain, there are about 10 million species of various genetic resources and two-thirds of them happen to be in the tropical countries. In the United States, for example, out of these plants, the retail value of drugs that are sold in the market is roughly of the order of about $40 billion. Now, how can we then have a regime, a global regime which recognizes the great and immense promise of biotechnology, and at the same time works out an arrangement which ensures that the fruits of this progress are equitably distributed. This, I think is the challenge before humanity when it comes to dealing with the promises and potentialities of biotechnology. Scientists and other administrators in the third world, in my opinion, have to apply their minds to these issues.

Finally, we look at the other convention, the Framework Convention on Climate Change, the issues that are of concern to us. Now we are here in area of uncertainty. We cannot quantify whether what is happening will necessarily bring about irreversible changes in climate. But, in human affairs, precaution is better than cure, and since we are as interested in the future of humanity as anybody else, we have, therefore, a vested interest to cooperate with the rest of the world in ensuring that no irreparable damage is done to the climate, and that global warming is controlled. But what are the optimal strategies to deal with these problems from the third world angle? How can the management of forests, the conservation of forests, the development of energy systems in our countries, how can these be developed, in a manner that nobody would accuse the countries in the third world that they are being a nuisance. We owe it to ourselves because, whether we like it or not, we cannot follow the energy-intensive patterns of development of Western countries. As I have often said, the challenge before the sub-continent India, Bangladesh, Pakistan, Nepal, Bhutan—is not to wait for the American levels of per capita income to abolish poverty, but to find credible strategies to remove abject poverty at a per capita income of no more than $400 to 500. That, I think, is the biggest single challenge for social engineering, in which our scientists, our technologists, and our administrators must cooperate. If you are going to wait for the growth of per capita income levels to US or even of South Korea, then, I think, quite honestly, you must confess that poverty would remain as the Victorians used to say the 'the poor have been with us, they will continue to be with us, so what?' If you really take the removal of poverty seriously then we have to look at the whole system of sustainable management of forests, natural resources, the use of energy systems. How can energy use be expanded without damaging the environment and how can energy supply be made more accessible to the poor people of the country? I do recognize, the problems of fuelwood are important. But if you are going to treat rural India all the time as a second class citizen, I don't think the people of rural India will accept that title. There will be, if you do not improve the quality of living in the rural India, reckless migration of people from rural areas to the cities. Even though they cannot get jobs, they will float around in the hope that one day some of them will get jobs, and you will have urban chaos.

The way to beautify India's cities is to start by beautifying India's villages. Therefore, do not perpetuate the solution that rural India can accept the use of old fashioned fuelwood while the rest of India will shift to LPG or electricity. I think rural electrification and more modern means of meeting the needs of energy in the rural India has to be accepted as a priority, if you want the end of premature migration of rural people into cities. We have to create new functional townships. These functional townships which will have in my view all the facilities of modern life. People can cycle to these functional townships to take advantage of those facilities, and yet can continue to live in their villages. Thereby we avoid excessive investment in social overhead capital—in housing,in sanitation—that should come later on. But, improving the quality of life in rural India has to be along modern ways, We cannot simply say modern life is for a small segment of our population which lives in urban areas and 75 per cent of our people would continue to live in drudgery, and that they would accept that fact year after year. Therefore, I submit to you that in the management of energy systems, meeting the energy needs of rural areas in a cost effective manner, has to be high on the agenda of research and policy planning, and this is another area where I feel there is need for lot more co- operative and creative enterprise.

These are some of the thoughts which occured to me as I came to this meeting. As I said to you, I have not made a detailed study of environmental issues but I do have to deal with them in my day to day working as Finance Minister, and I feel that some of these issues are important. There are one or two more issues that I do want to talk about.

The whole issue of nuclear safety. There is almost a conspiracy of silence. We have to face that issue. I think nuclear energy is a fact of life. In India it is a fact of life, in Pakistan it is going to be used, but there are aspects of ensuring that this supply is as safe as humanly possible. What are its implications ? We have in our country a mechanism to ensure safety. But there is very little public discussion of these issues. Some day, some accident happens and then the whole thing will come into disrepute. But this issue should, I believe, be discussed, debated, so that the country has the assurance that things like Chernobyl never happen in countries like ours. We are an open society, and that is the advantage of open societies, of democratic systems, that we can take advance action, whereas totalitarian setups wake up when it is too late. I think, our scholars should take full advantage of the opportunities of working and researching in the framework and in the atmosphere of an open society committed to free debate and freespeech.

Finally, the whole area of education. Ultimately, the defence of the environment and the defence of the ecosystem, and for that matter the defence of secular values, must rest in the minds of our people. Where do you began except when you start educating a child? I think it was a great merit of the Father of Our Nation Gandhiji that he appreciated that truth more than anyone else among modern thinkers. He wanted to relate education to the needs of life of our people. He wanted to have an educational pattern which would teach people to live in harmony with nature, unlike this western pre-occupation of control over nature. The Gandhian value system always emphasized on man or woman living with harmony with nature. Now, it may be that we cannot replicate what Gandhiji said. May be it is too idealistic. But, I think, that in our educational processes, concern for environment and concern for equity, must be integral parts of our thought processes. It is only then that you can build a society which will value environmental protection, which will, at the same time, be an integrated society and a society which the coming generations could be proud of. There are today many good things happening in our societies, but there are many things which are a cause of worry and a cause of concern. Let us wake up before it is too late and in ushering in that brave new world, I think, knowledge has to be the most important input. The famous Cambridge economist Lord Keynes once said that 'for good or for bad, ideas are often far more important than vested interests'. I think that is the challenge to all those who are committed to intellectual endeavour. That is the hope, that is the inspiration which ought to be guiding us.

Valedictory session: presidential address

Hon'ble Shri Kamal Nath
Minister of State for Environment and Forests

Hon'ble Finance Minister, Dr Manmohan Singh, Dr Pachauri, Mr Dessau, Mr Cyril Poonamperuma and distinguished guests.

I am very happy to be here at the Post-UNCED Seminar which is perhaps the first of its kind being organized after the Rio Summit. What do we look at when we sit at this seminar—do we look at the future or the past? In 1972 there was a conference on environment at Stockholm. On that occasion Mrs Gandhi drew attention to the linkages between environment, development and poverty. Twenty years later 115 Heads of Government assembled at Rio de Janeiro and the issue was environment and development. The greatest single gain for the South was the recognition by the North that poverty and development are central themes to environmental protection. We cannot isolate environment and poverty and development. Over the last two years spent in negotiations, whether over the Biodiversity treaty, whether the climate change treaty, whether the wranglings over Agenda 21, or whether over the Rio Declarations, it was very important that the North comprehends this fact.

In 1972 the central global issues were how man would survive with man. In 1992 the issues were how man would survive with nature, and these shared concerns as well as the intent to act on these concerns was what made 115 Heads of Governments come to Rio. Prior to that a great deal of effort had been spent in negotiating the various Conventions, Agenda 21 and the Rio Declaration. The road from Rio that you have been deliberating on for the past two days is not an easy road. We have the Framework Convention on Climate change, biodiversity and the huge document, Agenda 21, which takes into account cross sectoral issues cutting across the entire spectrum relating to sustainable development. Another major gain from Rio is the greatly increased awareness about these issues, and I see this manifest in India not only in enlightened NGO groups but also in small villages various districts. Issues that were known 10 years ago only to scientists or major NGO groups are now known to school children. This is the major change that has taken place in India and across all countries. The environment is not an issue only within nations, but is transnational, It affects the globe, and country on this planet.

What you have deliberated in the last two days is very important. Environment cannot be a issue for Government alone to deal with. It has to be a movement of the people. We cannot control pollution by an inspector or a meter. It has to happen by awareness of the people, citizens groups, NGOs and individuals. Government can merely act as a catalytic agent.

When we look at the Post-Rio scenario, looking at our region we find so many commonalities in terms of culture, poverty and development, in terms of economic path we have been following. But how do we harmonize these in our region so that we specific problems encountered by others. No country can possibly ape another country. India's development path cannot be same as that of countries of the North. We have a repository of knowledge about how some of them are the world's biggest polluters. How their per-capita pollutant load is the highest on this planet. We have the figures of energy consumption patterns at the start of the industrial revolution. We have the

present day figures for Japan and USA. What should we choose? Could we have our agricultural revolution merely by tractors. It was not tractors that led to an agricultural revolution in India. Tractors are for 30 acres or 40 acres of land. Our land holdings are much smaller. We have to look at country specific methods—India specific methods. Of the total energy used in our country fuelwood accounts for 40 to 50%. Our total input by the forestry sector to the Indian economy outside the market economy is in excess of Rs 20,000 crores per year. If we were to calculate the fuelwood collected by the poorest of the poor in our country (which is a rare subsidy to the poor) and attach a value, to fodder for 430 million cattle, adding it up gives us a staggering a figure in excess of 20,000 crores per year which is not reflected in our market economy accounts. If our forest management systems did not help us to service this need of 160 million tones of fuelwood, what would be the quantity of alternative energy source required? What would it cost our country? How could Dr Manmohan Singh find the foreign exchange to import the oil? How would the poor be subsidized: 400 million people? A population larger than that People bigger than the size of Europe who depend upon the fuelwood serviced by our forest sector. Now these are India specific situations.

But while at the negotiations on the forestry principles our stand was that we have managed our forests. True we have had our problems. A year and half ago we went to the IMF. Dr Manmohan Singh, had he chosen the forestry route, cutting a small portion of our forest in the North-East would have got him the required 500 odd million dollars that he needed. But India as a country did not choose the forestry route. The revenue of the US or Canada may be 50 billion dollars in terms of timber revenue, but for us our forests are not a revenue resource. While looking at the future we have to look at India specific situations. We strongly opposed the forestry convention, because we cannot look at forests as CO_2 sinks, or emissions sinks or look at the forests through dust particles. Forest have to be perceived in the India context differently. We could manage our forests with International cooperation. First and foremost for the benefit of our people and then as a concerned and responsible country in the world. Our forestry legislation is perhaps the toughest in the world and all countries subscribing to such conventions do have the kind of such legislation that we have had for years. So we would like to see in the future, international co-operation in our forestry sector, which also helps us preserve our bio-diversity. Commensurately, in terms of impacts on climate change, we would be fulfilling our responsibilities and we would look at the North countries in terms of stabilization and reduction of emissions. We would like the North to talk of transfer of technology, while talking about global environment. We have to talk of clean technologies and not cleaning up technologies, and this means transfer of these technologies in non-commercial terms, because here we are talking of a shared concern. From Rio we came out in another orbit-an orbit of a partnership-outside the conventional political and economic blocs. So we would like to see the transfer of these technologies and the modalities of such transfers to be worked out. We have a Framework Convention for this, from which protocols have to flow, and these protocols must take into account the modalities of the transfer of technologies. We cannot get into this while respecting intellectual property rights (IPRa). IPRs cannot become an instrument to negate what we sought, or will seek in the future. There has to be transfer of technology on non-commercial terms if we are to have a global partnership. If we are talking of burdens today, we are in the threshold of development. This applies not only to India, but to our neighbors, SAARC countries

and our neighbors outside the SAARC countries. So we have to talk about who would share the burdens of incremental costs, and what will the incremental costs come with, and what kind of conditionalities will be involved. The same kind of conditionalities that we have seen in the past or would they come out of shared or differentiated responsibilities. What kinds of funds flow are going to have in the future.

The Rio Declaration signifies the political will of world leaders-that political will has to speak louder than words. The G7 meeting held two months ago does take into account the commitment of Rio, but, they must flow into concrete programmes. We have agreed on a reaffirmation of the GEF. And we would like that GEF recognize these concerns and not merely be a window of the World Bank. The multilateral funding mechanism is accountable to the Conference of Parties. It should have the edge, the tone of bias if we are talking of shared concerns. We did see this in Rio, we had some difficult movements.

Our SAARC region possesses some of the greatest biodiversity on this planet. We have to maintain linkages between bio material and bio diversity. We have preserved, maintained our bio diversity. Looking at the last 100 years we find how the North chose a path where they did not care about biodiversity. Consider the forests in Finland and Sweden. When were these planted. A very fascinating picture emerges, and it has nothing to do with biodiversity. Forests were planted for industry. This was 60—70 years ago but they were not needed 20 years ago. Alternate energy sources were available. Forests were planted for the steel industry. The point I make here is that while being country specific, we should be region specific also. We have here a major responsibility because our country in this region, and some countries a lit bit outside this region have as I said the greatest bio diversity on this planet. This bio diversity is now extremely important because great strides in biotechnology in terms of agriculture, medicine, pharmaceuticals. In terms of future sustainable paths, Biotechnology has a very major role to play. The Biodiversity Convention has established a linkage between biomaterial and biodiversity. And I do hope that we would be able to set this off the ground in the months ahead.

In India our ethos, mythology, our religions have close linkages with the environment. For many years, we have had a national pollution abatement policy, a national conservation policy, and a national forest policy since 1988, and these were not made for Rio. We how have to inbuild environmental concerns in what we do, but of course we cannot place environment before people or development. The perceived differences between environment and development should be blunted not sharpened and we have to work on the financial mechanisms, the financial incentives. Our national pollution policies lay down that the fiscal instrument will be used-to solved the pollution problem of cities. In Delhi 65% of pollution is altributable to vehicles. Shut down all travel and buses and we can bring it down to 15%, but is this the solution? It has an economic dimension. It is easy to say to get the vehicles 10 years old off the road. When families survive on it, when movements of goods depend on it—what we require is unleaded fuel for which we need catalytic convertors. Just a few examples. With these policies before us, the fiscal instruments are to assist, to catalyze the building in environmental concerns into what we are doing in our projects, in our path to development. Of course, we would like such instruments to be as revenue neutral as possiblem but some times it may be possible and sometimes it may not be. In the matter of the environment India has been a responsible country. We look at the future with hope. We are optimistic about the interface with our neighbors and with developed

countries, because we are not in this as a Government but all of us (you, me and all of us) are trustees for the future.

Thank you very much.

An overview of post-Rio political economy issues

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Introduction

This paper attempts, in two parts, to examine some impacts of the United Nations Conference on Environment and Development at Rio de Janerio on particular political economy issues related to global environmental governance. Part I examines political economy implications of the Rio process through an analysis of the major documents originating from Rio.[1] It outlines some implications for major issues including sustainable development, sovereignty, the development of international law, the international economic system, financial mechanisms, the status of local and indigenous communities and the prescribed policy instruments.[2] Part II identifies the minimum requirements of a successful multilateral regulatory regime (the Convention-Protocol model) as identified by a number of analysts. Using information from Part I, the Rio regimes are compared with these in an effort to gain a preliminary view of their relative success and failure and an insight into their potential for the future.

The dual process of conflict and accommodation between contending positions taken by developed countries and developing countries in UNCED is evident from all the documents emanating from UNCED. This is perhaps best exemplified in the Rio Declaration which is portrayed as the international consensus on the future direction of global environment and development. Further, it is designed to give a more formal structure to the 'global partnership' considered necessary to operationalize environmental imperatives related to development and growth. The Declaration provides a framework of values welded into an attempted integration, but the specific Conventions show up more clearly areas of conflicting interests. Apart from balancing these interests, local political, social and economic perspectives will also enter into the process of predicting the future scope of specific rules or principles outlined by Rio. The task is bound to be complex, and it is difficult to conceive of an easy unanimity in the results of the process.

Part I—the conventions examined

General comments—implications for international law

The Rio Conventions are a hybrid of two types in the commonly accepted taxonomy of treaties.[3] The first kind of treaty is of a norm creating character or forms the basis for

[1]The documents being considered are the Rio Declaration, the Framework Convention on Climate Change and the Biological Diversity Convention.

[2]Implications for transfer of technology and associated questions of the subsequent status of intellectual property rights are not being considered for reasons of scope.

[3]For an elaboration of the different types of treaties and their relative application, see Henkin, Pugh, Schachter and Smit, *International Law, Cases and Materials*, Second Edition, West Publishing Co., St. Paul, Minnesota, 1989.

the creation of a general rule of international law. The second establishes a collaborative mechanism for states to regulate or manage a particular area of activity. The norms that the Rio treaties are trying to create (in the context of the first type of treaty) relate to the acceptance of sustainable development as a fundamental principle of international economic and environmental organization. This forms the background of the UNCED process. More specifically, the individual treaties attempt to regulate particular types of activity that have implications for sustainable development. These are: the preservation of biological diversity and of the climate system. This second type of treaty is typically characterised as an international regime or as international administrative law. Within this framework, the treaties develop different mechanisms to address specific problems.

An important feature of the entire process is that it represents a new stage in the progressive development of international environmental law. The three Rio documents take up the thread of certain principles of international environmental law and policy and have codified them in the context of the specific problems that they address. It would be naive, however, to imagine that ambiguities related to international environmental law have disappeared as a result.

Despite the fact that the Rio Declaration is non-binding, its worth as an international (legal) document cannot be ignored. The Declaration perhaps possesses the potential which the UDHR (Universal Declaration of Human Rights) did when it was adopted. The latter document provided the basic framework from which followed the International Covenant on Civil and Political Rights and the International Covenant on Economic Social and Cultural Rights, as also a host of declarations and conventions concerning specific human rights issues. The Universal Declaration, along with the two Covenants, are regarded today by a substantial body of responsible legal opinion as part of customary international law. If subsequent state practice roots itself in the Principles of the Rio Declaration, as can be expected, it may prove to be an important source of interpretation in the formulation of global environmental law and policy, and an important sector of customary international law could come into existence.

This is reinforced by the fact that the Climate Change Convention and the Biological Diversity Convention, which will become binding, contain Articles based on specific Principles in the Rio Declaration. Through the course of this paper we identify areas in which the Rio Declaration along with the Climate Change Convention and the Biological Diversity Convention are providing the impetus for the further development of emerging principles of international law. These include, as we shall see later principles such as intergenerational equity, the right to development, the precautionary principle and the necessity of environmental impact assessments.

All the documents acknowledge human responsibility for causing the specific global environmental problem that they address. Also, the message of the Rio process is quite clearly anthropocentric. Only the concerns and rights of humans are implicated and there are no provisions for rights of animals or any other living or non-living entities. We now turn to an examination of specific political economy issues.

Sustainable development

Sustainable development constitutes the stated goal of the UNCED process. However, an analysis of the documents reveals that they provide no clear definition of the concept of 'sustainable development' and that sufficing interpretations have to be drawn

from the texts. The literature on the meaning and content of sustainable development is too extensive to review here, but a brief statement may be essayed.

Definitions

The most widely accepted definition of sustainable development is provided by the UN's World Commission on Environment and Development, which described it as development that 'meets the need of the present without compromising the ability of future generations to meet their own needs.[4] This articulation of sustainable development has led to attempts to spell out in greater detail the specific features of this concept. Some alternative definitions that outline the content of sustainable development are given below.[5]

An economic definition places greater emphasis on the use of 'renewable natural resources in a manner that does not eliminate or otherwise diminish their...usefulness for future generations'.[6] Alternatively, in a welfare state perspective, sustainable development has been described as development that improves health care, education and social well being.[7] A third, technology based interpretation is that sustainable development includes a 'rapid transformation of the technological base of industrial civilization'[8] with the use of new technologies that should be cleaner, more efficient and less natural resource intensive.[9] An ecological definition of the concept is that it involves 'improving the quality of human life while living within the carrying capacity of supporting ecosystems'.[10]

There do, of course, exist linkages between each of these concepts\ interpretations of sustainable development, which indicate that these could be considered aspects of the same process. These definitions are intended to be merely pointers in terms of content and not a description of the debate on the subject.

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[4]World Commission on Environment and Development, 1987, *Our Common Future*, Oxford University Press, New York.

[5]These are based on definitions provided in World Resources Institute, *World Resources 1992-93*, Oxford University Press, New York, 1992.

[6]Robert Goodland and George Ledec, "Neoclassical Economics and Principles of Sustainable Development," *Ecological Modelling* Vol 38 19870 p 36. Quoted in *World Resources 1992-93*.

[7]United Nations Development Programme, *Human Development Report 1991*, Oxford University Press, New York, 1991. Quoted in *World Resources 1992-93*.

[8]James Gustave Speth,"The Environment: The Greening of Technology," *Development*, Vol.2, No.3, 1989. Quoted in *World Resources, 1992-93*.

[9]George Heaton, Robert Repetto and Rodney Sobin, *Transforming Technology: An Agenda for Environmentally Sustainable Growth in the 21st Century*, World Resources Institute, Washington D.C., 1991. Quoted in *World Resources 1992-93*.

[10]IUCN-the World Conservation Union, United Nations Environment Programme and World Wide Fund for Nature, *Caring for the Earth*, IUCN, UNEP and WWF, Switzerland, 1991. Quoted in *World Resources, 1992-93*.

Interpretations

The Rio Declaration contains numerous references to sustainable development. In the absence of an explicit definition, a proximate interpretation can be derived through an examination of the text of the various Principles. Its implicit contents may be some or all of the following:

(a) 'a healthy and productive life in harmony with nature,' (Principle 1);
(b) 'environmental protection is an inherent part of the development process,' (implying perhaps that development that does not protect the environment is not sustainable) (Principle 4);
(c) 'eradicating poverty,' (which is seen as an indispensable requirement for sustainable development) (Principle 5);
(d) as related to 'production and consumption,' and 'appropriate demographic policies,' (Principle 8) and;
(e) involving 'exchanges of scientific and technological knowledge, and by enhancing the development, adaptation and diffusion of new technologies, including the transfer of technologies' (Principle 9).

In line with the different definitions listed in Section 2.1 above, (a) and (b) could be said to represent the environmental or ecological aspects of sustainable development, (e) involves the technological component and (c) and (d) relate to the economic and human aspects. Developing country concerns around the UNCED process have predominantly related to (c) and (e).

Poverty eradication is a priority in developing countries and the focus of most development measures. The Climate Change Convention and the Biological Diversity Convention both explicitly recognize that economic and social development and poverty eradication are the first and overriding priorities of developing countries with respect to the fulfilment of their commitments under the Conventions.

The importance of the technology transfer issue is obvious from the protracted wrangling over the Climate Change and Biological Diversity Conventions. The developing country argument, as is well known, has been that to follow sustainable development paths and to fulfil obligations that may arise under the two conventions, the transfer of funds and technology are essential. The crux of the post-Rio environmental debate will relate to the mechanisms to deal with poverty eradication and transfer of technology.[11]

Likewise, the two conventions contain references to sustainable development. The Climate Change Convention describes sustainable development as requiring 'access to resources' (Preamble), and recognizes that sustainable development for developing countries means an increase in energy consumption. It states that all countries have the right to and should promote sustainable development (Article 3 (4)) and also holds that an open and supportive economic system would lead to sustainable development in *all* countries, especially developing countries. This is hard to swallow. First, it can be argued that a commitment to using more resources contrasts with the WCED definition of sustainable development, which aims to minimize the use of such resources. Second,

[11]The debate over mechanisms relates not only to institutions that will be set up to oversee the Rio agreements, but also over the appropriate policy instruments for the process. Developed countries are likely to argue that market friendly mechanisms and respect for intellectual property rights are essential, while developing countries will argue in favour of easy access to technology and the right to determine the appropriate domestic regimes to operationalize sustainable development policies.

as will be discussed later, it is difficult to imagine that there would be no losers whatsoever (at least in the short run) as a result of instituting an open and supportive economic system. (See Section 4 below).

The Biological Diversity Convention is fundamentally based on promoting the sustainable use of the components of biological diversity. This is defined as 'the use of the components of biological diversity in a manner and at a rate that does not lead to the long term decline of biological diversity, thereby meeting its potential to meet the needs of present and future generations' (Article 2).

The cumulative message from Rio as related to sustainable development is generally in keeping with the WCED interpretation. It is however entirely possible that national and international efforts to bring about sustainable development will lead to changed interpretations and a sharper focus on the issue. A close reading of Agenda 21, which intends to spell out the contents of a global sustainable development policy will be required to determine possible conflicts (in the context of both Conventions) with existing notions of the concept and with (potentially non-sustainable) development in general, since difficult choices, manadated by scarce resources, will probably have to be made at a later stage.

Intergenerational equity

The concept of intergenerational equity has as its basis a determination of the obligations of current generations to future generations and, consequently, the rights of current people to use resources available on the earth. This requires a focus on the relationship that each generation has to others. To define the notion of intergenerational equity, it is helpful to view the human community as a continuous partnership across all generations, whose purpose is to realize and protect the well being of every generation and to conserve the resources of the planet for this purpose. The Rawlsian notion of the 'veil of ignorance' implies that each generation will want to receive the planet in at least as good condition as every other generation.[12]

Intergenerational equity can also be defined in terms of intergenerational (inter-temporal) externalities.[13] An intertemporal externality would be one which involves benefits accruing to the present generation, reaped at the cost of future generations (and, possibly, the other way around as well). It is the imposition of a cost at a time later than the time at which the benefit is received.

Two kinds of equity are embodied in the WCED definition of sustainable development quoted in Section 2.1. The first is equity for people living now, who do not have access to natural resources or social and economic goods; and the second is intergenerational equity as defined above. There exists the potential for conflict between these two notions, especially since the two Conventions do not always draw clear distinctions between them. Equity, therefore, is an obvious subject for future protocols.[14]

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[12]For an elucidation of the concept of a veil of ignorance, see John Rawls, *A Theory of Justice*, Harvard University Press, Cambridge, MA, 1971.

[13]Gerard C Rowe, 1991, "International Environmental Sustainability: Policy and Law, *The Science of the Total Environment*, 108, (1991).

[14]For reasons of scope, we do not discuss details of various equity formulations in this paper.

Some analysts point out that environmental issues in developing countries cannot be resolved without alleviating poverty, and call for redistribution of wealth and incomes spatially, both within countries and between rich and poor nations. Others stress intergenerational equity and focus on the need for reducing current consumption to provide for investments that build up and maintain resources for the future. Despite the fact that sustainable development implies, primarily, intergenerational equity, it is necessary to be aware of the ways in which uncorrected interspatial equities may mask or contribute to the existence of intertemporal equities.[15] Where spatial inequities are not prevented, or at least compensated for, societies tend to be unaware of possible intertemporal inequities and the capacity of institutional structures to prevent them are likely to be absent.[16]

The Rio documents seem to follow the line of argument that it is possible (and necessary) to do both. In calling for transfers of financial resources across nations, they try to address the issue of equity between nations (though not *within* nations). At the same time they all stress the need for intergenerational equity, both in terms of their embracing the concept of sustainable development and more explicitly, in their reference to intergenerational equity itself. This is done in the following manner.

Principle 3 of the Rio Declaration states that the right to development must be fulfilled so as to meet the developmental and environmental needs of present and future generations. In the Climate Change Convention intergenerational equity is referred to both in the Preamble and in Article 3 (1), in the context of the protection of the climate for present and future generations. Likewise, in the Biological Diversity Convention, this temporal form of equity is referred to in the Preamble, which resolves to conserve and suitably use biological diversity for the benefit of present and future generations. Further, in Article 1, the sustainable use of biological diversity—both in terms of needs and *aspirations*—is defined in terms of intergenerational equity. This could perhaps be interpreted as further delineating the concept of intergenerational equity, introducing a greater subjective element, since 'aspirations' could prove extremely difficult to define.

The right to (sustainable?) development

There are two moral and political imperatives behind the right to development itself which are based in the history of North-South political economy.[17] The first of these can be traced back to UNGA (United Nations General Assembly) Resolution 626 (VII) of 21 December 1952, which referred to the right of member states to freely exploit their natural resources, and is based on the principle that the individual State should have the right to control its own economy and thus develop in its own way. The second imperative is the idea that economic development as such is inadequate and that the performance of an economic system should be related to qualitative criteria based on human rights standards as well. Our analysis looks at the effect that UNCED may have

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[15]Rowe, 1991.

[16]A person intent solely on providing for basic needs is unlikely to be aware of his or her contribution to degrading resources that are necessary for use in the future.

[17]This section draws on Ian Brownlie, "The Human Right to Development," *Commonwealth Human Rights Unit Occasional Series*, Commonwealth Secretariat, London, 1990, for the history of the right to development.

had on the first set of imperatives relating to the right to development and will not refer to the latter.

The credit for the formulation of a *formal* right to development belongs to an eminent Senegalese jurist, Keba Mbaye, writing in 1972. By 1979, ECOSOC (Commission on Human Rights of the Economic and Social Council) of the United Nations had begun studying the right to development and in 1986 the UN had adopted a Declaration on the Right to Development based on the report of the Commission. The legislative history of the right is thus firmly based within the human rights agenda of the General Assembly and ECOSOC, two UN bodies traditionally dominated by developing country interests.

The December 1986 UNGA resolution contained an annex with a 'Declaration on the Right to Development' which spelt out the details of the content of the right to development. Elements of the right were held to be the following: the right of peoples to self-determination, the right of peoples to full sovereignty over their natural wealth and resources, an element of international economic justice, people-oriented development, development assistance and consequently the flow of funds from richer to poorer nations, international cooperation, disarmament and popular participation in the decision making process. This Declaration is not the only source of interpretation of the right to development but supporting evidence of the content is provided by a number of other international documents.[18]

The process of global environmental governance may be altering the content of the right to development. In stressing sustainability and intergenerational equity, the focus seems to be shifting from equity between present people (in different nations or in different parts of an individual nation) to include intergenerational equity. Developing nations need to be careful that this interpretation does not come to dominate the international environmental arena, and that issues relating to international inequities do also remain an issue on the agenda.

Sovereignty

One of the principal concerns of developing countries in the global environmental process has been to prevent any international jurisdiction over of what are considered national natural resources. This has been an important aspect of their position for a number of years. The Principles of the Stockholm Conference on the Human Environment declared that states have the 'sovereign right to exploit their own resources, pursuant to their own environmental policies and the responsibility to ensure that activity within their own jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction'.

While today the use of these resources is important mainly in the context of their economic value and exploitation, the depth of sentiment in developing countries on this issue must be seen against the backdrop of their shared colonial experience. This is the perception that many of their current economic problems (poverty, debt, low international commodity prices etc.) can be traced to policies of colonial regimes, which exploited the natural resources of colonial territories for their own advantage and deprived those territories of the opportunity of self-development.

Another argument is that for states to be equal players in a global partnership, it is essential for them to have independent natural resource exploitation policies. This

[18]See for instance, the Charter of the Organization of African Unity.

exercise of their sovereign rights, it is felt, is the only way to ensure their meaningful participation in any global process. They believe that the right and opportunity to exercise an autonomous exploitation of their own natural resources is a powerful factor in the maturation of a people to the full dimensions of statehood. These concerns were brought to Rio by developing countries.

A natural corollary to this perspective on sovereignty is the concern that international jurisdiction over natural resources should supplement and not supplant national controls. Further, that inclusion of global perspectives in the formulation of national economic policies should not necessarily imply the supersession of autonomous national control by any form of international jurisdiction.

This classic developing country concern is addressed in each of the Rio documents.[19] The sovereign right of States to exploit their own resources, pursuant to their own environmental and developmental policies... is clearly acknowledged in the Rio Declaration. The wording of this principle, however is not unambiguous. States are recognized as possessing sovereign rights over their 'own resources', without any details of what these include. It becomes especially necessary to define 'own resources' because things like the atmosphere, earlier considered unlimited free goods, have become scarce in the context of GHG accumulation. The enjoyment of these sovereign rights are limited only by consideration of their transboundary environmental impacts. It is possible to interpret this principle as defining the limits of 'own resources,' i.e. resources cease to be national to the extent that their exploitation can have adverse transboundary impacts.

A cautionary note needs to be sounded with reference to the sovereignty principle. While the existence of national control over natural resources is an important principle of international law, it must be recognized that any process of cooperative international decision-making requires, almost by definition, a degree of sacrifice of sovereign rights by states parties.

The Conventions recognize the fact that the activities being regulated lie within the realm of national jurisdiction. However, even the presence of non-binding exhortations to change this pattern of activity and to cooperate in international efforts can have the effect of restricting sovereignty. While most measures envisaged in the two Conventions depend on individual state action, states are under an implicit obligation not to carry out activities that go against the spirit of each convention, even if such activities are otherwise legitimate. The primary method of enforcement of such a principle is 'peer pressure' exerted by other nations that are part of the same treaty arrangement. It is also important to note the impact of the differential power of states in the international arena on this process.

More specifically, in the Climate Change Convention, commitments envisaged under Article 4 (1) and (2) envisage nations altering patterns of development and lifestyles, moving to less greenhouse gas intensive paths. To accept this implies some restrictions, voluntarily executed, but internationally determined. This is specifically true of developed country commitments under Article 4 (2), where a specific target of returning to 1990 levels by the end of the decade is alluded to. Again, while this is not a binding commitment, the existence of a specific number and date puts pressure on states to follow it.

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[19]In Principle 2 of the Rio Declaration, the Preamble in the Climate Change Convention and Article 3 of the Biological Diversity Convention.

In the Biological Diversity Convention it could be said that sovereignty might be affected due to the promise of access to biotechnology. Sovereign rights will be given up, albeit in a contractive framework that. Article 16 (1) states that access to resources is essential for the success of the convention, which can be construed as an implicit encouragement to give up sovereignty.

The international economic system

Global economic inequities have been part of the North-South political economy debate since the process of decolonization began after World War II. Traditional developing country demands for a new international economic order have diminished, but fears of economic imperialism linger and must be addressed by any process implicating the global economy.

One of the main (stated) priorities of developed countries is to move towards an international economic system that encourages or at least allows (if only in principle) freer trade and access to foreign investment (especially in developing countries). While the necessity of global partnerships and assistance to developing countries is accepted in principle, there is a concern among developed countries that the possible changes in lifestyles, the 'new and additional flows' necessary to enable developing countries to carry out environmentally sound development measures and the internalization of environmental costs to the polluter will distort current patterns of international trade and investment.

The meaning of an 'supportive and open' international economic system (which is held to promote economic growth and sustainable development in all countries) is also of potential importance to developing countries. Supportive could variously be interpreted as supportive to developing countries, implying concessional aid, technology transfer, easier access to markets and the like. On the other hand, supportive as interpreted by developed countries could mean an economic environment within developing countries that would support direct foreign investment, allowing easy access to exports and conforming to developed country intellectual property rights. Likewise, 'open' could be interpreted to mean open economies with free trade and direct foreign investment or, on the developing country side, easier access to technology and the removal of tariff and non-tariff barriers. Developing countries, therefore, are concerned that an operational interpretation of 'open and supportive' does not lead to unfavourable terms of trade and investment and does not attenuate their economic sovereignty.

There is some ambiguity involved in the wording of Principle 16 of the Rio Declaration, which also finds expression, in a slightly altered form, in Article 3 (5) of the Climate Change Convention. In this principle, national authorities are encouraged to promote the internalization of environmental costs and the use of economic instruments, on the basis of the polluter pays principle discussed below. At the same time nations are urged to do so without distorting international trade and investment. If the meaning of 'distort' in this formulation is loose and refers to deviations from the 'rules of the game' (i.e. free trade and an open investment climate), then the Principle has some meaning. If, on the other hand, the interpretation is a strict economic one, then it is difficult to understand how distortions will not take place as a result of changes in comparative advantage that will come about as a result of changed cost structures (as a result of the internalization of environmental costs to the polluter/producer). These issues will require resolution in the future.

Financial mechanisms

One of the most crucial questions that Rio poses is that of the structure and functioning of the international financial mechanism that will oversee financial transfers envisaged in the two conventions. This is so particularly because of the problem of developing country debt problems and repayment issues that loom large over international relations in this area.

In the Climate Change Convention, Article 11 (1) defines a mechanism for the provision of financial resources on a grant or concessional basis. This is to be accountable to the Conference of the Parties established under the Convention. The Conference of the Parties is to decide its policies, programme priorities and eligibility criteria. The Article goes on to say that the operation of the mechanism will be entrusted to one or more *existing* international entities.

Paragraph (2) of the same Article states that the financial mechanism shall have 'equitable' and 'balanced' representation of all parties within a 'transparent' system of governance. This is crucial because the extent of say that different groups of countries (developed and developing) will have over the disbursement of funds related to the financial mechanism and the basis on which lending will be carried out hinges on it. Developing countries will be eager to ensure that the functioning of the financial mechanism does not allow donors to direct and determine economic priorities (a la structural adjustment) in the countries they lend to through the FM (Financial Mechanizm). There is therefore a need to clarify the exact meanings of the terms in quotes above. Article 21 deals with FM and envisages that GEF (Global Environmental Facility) of the World Bank, UNDP and UNEP will be the international entity entrusted with this task. For the GEF to carry out this role in accordance with the guidelines in Article 11, its restructuring will become essential, with membership becoming universal.

Similar arrangements exist in the Biological Diversity Convention. Article 21 (1) states that the Conference of the Parties shall determine the policy, strategy, programme priorities and eligibility criteria relating to access and use of financial resources collected under the Convention. It envisages that the mechanism shall operate within a 'democratic' and 'transparent' system of governance. Article 39, on interim financial arrangements, again designates the GEF with the job. It specifies that the GEF must be fully restructured in accordance with the requirements of Article 21.

The financial mechanism and the restructuring of the GEF has implications for the process of decision making in the international arena. Thus far the GEF has functioned as a part of the World Bank system, with weighted voting on the basis of the number of shares held by members. This introduces an inherent bias in the system towards developed countries, especially the United States, which hold the majority of shares. The future structure of the GEF will have to be fine tuned in order to accommodate developing country concerns outlined above; this again could be the subject of a future protocol. It will also have to be designed in a manner that will ensure continued participation of the United States and other intransigent donor countries, who will obviously prefer the World Bank system for weightage according to contribution.

Indigenous and local communities

Some interested parties (especially representatives of various indigenous communities and their organizations that gathered in Rio in the parallel Global Forum) would

consider that the greatest failure of the Summit (and the Conventions that came out of it) was its inability to safeguard concerns of indigenous and local communities relating to their community resources and practices. A number of aspects of traditional lifestyles are implicated by the issues discussed at Rio. The treaties fight shy of accepting traditional rights, and leave this issue to the discretion of governments, which may not act in the interests of these communities.

Rio Declaration acknowledges that indigenous peoples and their communities and other local communities have a vital 'role' to play in environmental management and development because of their knowledge and traditional practices. Further it says that states should 'recognize' and duly 'support' their identity, culture and interests and 'enable' their effective participation in the achievement of sustainable development. Note that there is no mention of any *rights* nor does the Declaration explicitly prohibit activities that may harm traditional ways of life.

The Biological Diversity Convention implicates such traditional communities far more directly than either the Rio Declaration or the Climate Change Convention. Genetic resources (or the living matter that contains them) are often an integral part of life in these communities and regulatory attempts are extremely likely to affect traditional uses of these resources. The Biological Diversity Convention, in its Preamble, recognises the close and traditional dependence of many indigenous and local communities embodying traditional lifestyles on biological resources and the desirability of sharing equitably the benefits arising from the use of traditional knowledge, innovations and practices relevant to the conservation of biological diversity and the sustainable use of its components.

Article 8 (j) encourages states, 'subject to national legislation', to respect, preserve and maintain knowledge, innovations and practices relevant to the conservation of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices. Further, Article 10 (c) urges states to protect and encourage the customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements.

Also, 10 (d) encourages states to support local populations and develop and implement remedial action in degraded areas where biological diversity has been reduced. Finally, the contracting parties are encouraged, in accordance with their national legislation and policies to encourage and develop methods of cooperation for the development and use of technologies, including indigenous and traditional technologies of the objectives of the convention. The language throughout is dilute.

The words used: 'respect' 'promote', 'protect' and 'encourage', contain no strong directives to States Parties to actually incorporate measures that take into account the interests of traditional communities. This is an area of weakness in the Rio process. Traditional communities have in the past been adversely affected by development projects, especially those with significant environmental impacts. At the same time, there is an expanding consensus about the value of the knowledge systems developed in these traditional communities, which revolve around the sustainable use of resources available in their environment. Much of this knowledge and information has not been documented or recorded as yet. The principle of scientific uncertainty could have been extended to apply to indigenous knowledge, and this could contain clues as to useful applications. Also, if events in the recent past are any indication, local

communities can organize in resistance to development projects that they feel go against their interests. Any far sighted policy maker would be well advised to consider the interests of these communities in framing policies and implementing projects that implicate these communities.

Anticipated policy instruments

We look here at the extent to which the conventions further the progressive development of international regulatory instruments for the control of the environment. Legal liability regimes, economic regulation and environmental impact assessments are envisaged as possible instruments in the Rio Declaration (Principles 13, 16, 17 respectively), though not all instruments are emphasised in each Convention.

Polluter pays principle

In the Rio Declaration the polluter pays principle is stressed both in terms of the development of national laws of liability and compensation and the development of economic instruments. The idea behind the principle is to internalize the costs of pollution to the polluter. Principles 13 and 16 specifically address legal liability and economic instruments, respectively, though no mention is made of how an appropriate choice would be made between the two. The selection of a particular instrument can have deep implications for developing countries, since they place differing burdens of responsibility and cost on them.[20]

The Climate Change Convention does not explicitly accept polluter pays, though are implict indications that this concept is at play. The Preamble notes that the largest share of GHG emissions originated in developed countries, and throughout the document, 'common but differentiated responsibilities' are referred to in addition to capabilities. It could perhaps be construed that these are outlined on the basis of a historical polluter pays principle for GHG accumulation.

The Biological Diversity Convention contains references to liability in the case of harm caused due to the release of genetically modified organisms as under Article 8 (g) and (h). Article 14 (2) empowers the Conference of the Parties to examine the issue of liability and redress, including restoration and compensation, for damage to biological diversity, except where such liability is a purely internal matter. For both Conventions, more sophisticated liability instruments could be developed as a protocol.

Information and notification

Principles 18 and 19 of the Rio Declaration refer to information and notification requirements in case of transboundary environmental harm. The issues addressed by these principles appear to be far more dilute than what may be mandated by environmental realities. Principle 18 for instance, requires states to notify other states of any natural disasters or other emergencies that are likely to produce *sudden* harmful effects on the environment of those states.

Further, the international community is enjoined to make every effort to help states so affected. The language of the principle is ambiguous. What is implied by 'other emergencies' is unclear. If disasters such that at Chernobyl is the target, then the Principle has some value, otherwise, it remains fairly toothless. Secondly, the interna-

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[20]See P. Ghosh and A. Jaitly, *Legal Liability vs. Administrative Regulation: the Problem of Institutional Design in Global Environmental Policy*, paper presented in this Seminar.

tional community is required only to make 'every effort' to assist the affected states, with no firm commitment necessary to repair damage.

The interpretation of Principle 19 depends, to a great extent, on that of 18. In it, states are required to provide 'prior and timely notification and relevant information to potentially affected sates on account of activities that may have a *significant adverse transboundary impact'* and to consult with those states at an early stage...'. The meaning of this phrase hinges on what was meant by 'other emergencies' in the Principle 18. If this addressed the Chernobyl type situation, then it could perhaps be assumed that Principle 19 is aimed at activities that contributed to other (global) environmental problems that are slower to develop (such as climate change).

In the Biological Diversity Convention, Article 14 (1) (c), (d) and (e) deal with similar information and notification requirements. Article 14 (1) (c) encourages the states parties to promote, on a reciprocal basis, the exchange of information, notification and consultation on their activities 'that are likely significantly to affect adversely the biological diversity of other states or areas beyond their jurisdiction'. Clause (d) of the same Article enjoins states to immediately notify potentially affected states of threats to their biological diversity in the case of grave or imminent danger or damage originating under their control.

The requirements under the Rio Declaration are merely for states to notify, inform and consult, with no mention made of methods to solve the problems created by such activities. This can set a dangerous precedent for future environmental policy making based on the Rio Declaration. In the Biological Diversity Convention, however, clause (d) enjoins states to initiate action, in addition to information and notification requirements, to prevent or minimize such danger or damage.

Environmental impact assessments

Environmental impact assessments (EIAs), already a part of environmental language and policy all over the world, are also strongly recommended as a policy instrument by the Rio process.

Principle 17 of the Rio Declaration advocates the adoption of EIAs as a national instrument, for activities that are likely to have a significant adverse impact on the environment. These are to be made subject to the decisions of a competent national authority. The Climate Change Convention refers to EIAs in Article 4 (1) (f), which refers to the introduction of climate change considerations in policy formulation. It may be significant that EIAs are the only instrument specifically mentioned as an 'appropriate method' to minimize the effects of climate change on the economy, public health and environmental quality. Article 14 of the Biological Diversity Convention encourages contracting parties to introduce appropriate procedures requiring EIAs on projects that are likely to have a significant adverse effects on biological diversity, and further, allowing for public participation in the process.

Part II—successful international regimes

Was Rio a success? Did concerned parties come away with what they were looking for? A basic condition for the success the arrangement is political acceptability. This, at the risk of stating the obvious, forms the basis for the successful conclusion of any negotiated process and each of the features listed below help in making the convention

politically acceptable.[21] We identify here six features considered necessary for the success of an international regulatory regime and see how the Rio Conventions compare with these.

Flexibility

A Convention-Protocol model of international regime must be flexible in its ability to deal with, among other things, scientific uncertainty and different national concerns.

Both Conventions recognize different groups of countries, based primarily on varying types of national concerns. The primary classification of countries is on the basis of the developed/developing country distinction. This divides the signatories into two distinct groups, with different sets of commitments. Developed country commitments are somewhat more stringent and are implicitly based on first, their responsibility for causing the problems and, second, their ability to pay for measures to solve them.

A secondary set of classifications is on the basis of more specific characteristics, such as those dependent on fossil fuels as users, producers, exporters and importers and countries that, for different reasons, are considered more susceptible to the negative impacts of global warming or the loss of biological diversity. These include least developed countries, small island states, countries with low lying coastal areas, those in semi-arid regions, or those with fragile mountain eco-systems. One of the reasons behind this method of classification could have been to provide the flexibility required for different countries to sign and, further, to adhere to their commitments.

As mentioned above, it is also important that any arrangements to deal with climate change and the loss of biological diversity take specific account of the prevailing uncertainty. This will enable future responses to be tuned to deal with possible changes in the associated scientific facts, given an adequate review mechanism.

Article 4 (2) (d) of the Climate Change Convention provides for the review of developed country commitments in the light of best available scientific information. Based on this, the Conference of the Parties can take appropriate action, including recommending amendments to the Convention. Article 7 (2) (a) enjoins the Conference of the Parties to 'periodically examine the obligations of the Parties and the institutional arrangements... ' in line with the 'evolution of scientific and technological knowledge. In the Biological Diversity Convention, similar arrangements exist under Article 23, which gives the Conference of the Parties the task of review, on the basis of, in paragraph (b) of the Article, scientific, technological and technical advice. The process, therefore, does allow for sufficient flexibility.

Inclusiveness

For a comprehensive solution to global problems with multivariate causes, a convention must look for inclusiveness: of actors, of all the sources of the problem being addressed and of possible solutions.

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[21]Details of what the features of a successful convention should be were gleaned from, amongst others, the following articles: Ajay Mathur, "Political Issues in the Formulation of a Climate Change Convention," paper presented at the Global Forum, Rio de Janerio, June 1992, Ligia Noronha, "Background Note on the INC Negotiations," Tata Energy Research Institute, New Delhi, 1991 James Sebenius, "Designing Negotiations for a Successful Regime," *International Security*, Spring 1991 (Vol 15, No.4) and Oran Young, "The Politics of International Regime Formation: Managing Natural Resources and the Environment, *International Organization*, Vol 43, No.3, 1989.

One of the features of the Convention-Protocol model of international agreements in which universality is desired, is that in an effort to appeal to a wide group of countries, principles often have to be diluted; this has been called the 'lowest common denominator'.[22] This can reduce the value of the treaty arrangement as a whole. If, on the other hand, this is not done, it can be expected that some countries—or groups of countries—will not become part of the treaty arrangement.

The Rio documents have suffered from both the above problems. The Declaration attempts to be all things to all people, perhaps because it is a declaration and not a convention, and also because it purports only to provide a framework to guide environmental law and policy making in the future. In the Climate Change Convention, it was hoped that developed countries would arrive at specific (CO_2) emissions reduction targets. United States refusal to accept such targets consigns the subject to the realm of a future protocol, even though some nations might adopt unilateral reduction targets. In the Biological Diversity Convention, despite the presence of weak and mitigating language, the United States refused to accept provisions relating to the transfer of biotechnology and associated implications for intellectual property rights and did not sign the Convention. This significantly detracted from its value and the failure to include the United States is one of the primary weaknesses of the process.

It is also necessary for a convention cover all the sources or activities that cause the problem being addressed. In the Climate Change Convention all activities generating all types of GHGs (except those covered by the Montreal Protocol i.e. CFCs) are covered and no differentiation is made between different sources of GHGs. The Biological Diversity Convention refers to the protection of all sources of biological diversity.

Accommodating domestic constraints to international cooperation

Countries can face a number of purely domestic constraints to international cooperation. These could reduce their ability to contribute to and participate effectively in implementing the rules and mechanisms established under the regime. These constraints need to be accommodated.

Global environmental issues are not generally the subject of popular debate in developing countries, primarily because of the pressures they face from the requirements of development itself. Such pressures can include growing populations, low standards of living and various other social and economic problems. The imperatives of development are recognized throughout the Conventions, and as we have seen in Part I, the right to development has been strongly reaffirmed, though in the altered garb of sustainable development. In the Climate Change Convention, the Preamble recognizes that energy consumption in developing countries will grow to meet the needs of social and economic development. The extent to which development concerns will predominate over environmental ones under the Conventions remains to be seen.

Interest groups within each country have a role to play in the run-up to a country's ratification of a convention. This is particularly true if the regulated activities are likely to have a significant effects on the domestic economy and lifestyles. These groups, if powerful enough, can affect the stability of governments, cause major

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[22]Sand, Peter H., 1990, *Lessons Learnt in Global Environmental Governance*, World Resources Institute, Washington, DC.

changes in policy orientation and form coalitions that could make the domestic functioning of a treaty regime extremely difficult.

With respect to the Climate Change Convention, the major interest groups that could be negatively affected by its ratification include oil and coal producing companies, power producing utilities and GHG emitting industry in general. The Convention therefore fights shy of setting specific targets for emissions reduction -- something that would seriously affect these groups—and seeks instead to accommodate the positions of powerful lobbies such as oil companies, by referring instead to the need to cater to the interests of *countries* (oil-dependent, producers, exporters) that would be affected by international GHG emissions standards.

In the Biological Diversity Convention, the main industrial interest groups with a stake are pharmaceutical companies and other biotechnology patent holders. These groups have had a large role to play in the United States' non-ratification of the Convention. These groups feel that the transfers of biotechnology envisaged under the Convention would compromise resources invested in R & D. The Bush Administration's position on the Convention, in line with the above thinking, has therefore been that it affords inadequate protection to the holders (current and future) of intellectual property rights.

Another group whose interests will be affected by the Biological Diversity Convention are indigenous and local peoples. However, as we have seen, these groups have not gained any major benefits under the Convention, and some analysts would point out that their position could be worse after the Biological Diversity Convention comes into force. These interest groups, however, have less leverage on their governments, which therefore feel that they can be sidelined.

Enhancing the scientific and technical capabilities of developing countries can also enable a country to meet its commitments under a Convention. The Climate Change Convention, in Article 4 (1) (g) and Article 5 refers to such capacity enhancement. The former refers to the necessity of promoting scientific and other research related to climate change and clause (c) of the latter enjoins Parties to 'take into account the particular concerns and needs of developing countries and cooperate in improving their endogenous capacities and capabilities' and, to participate in efforts related to support and develop international and intergovernmental efforts to deal with climate change.

Politically acceptable rules

The actions prescribed by a Convention-Protocol model have to be acceptable and lie within the realm of practical possibility. It is therefore necessary to define at the outset the distribution of rights and responsibilities arising from the conventions.

In the case of the Climate Change Convention, this translates into possible future resource transfers, which hark back to the question of intergenerational vs. spatial equity. Developing countries were concerned that in focusing on the needs of future generations, current perceived imbalances in global patterns of production and consumption will be ignored in measures for the protection of the environment. In this framework, it was claimed, there was no scope to do anything for external indebtedness and the eradication of poverty.[23] The Climate Change Convention deals with the issue by giving poverty eradication and other development concerns an important place as a

[23]Indian position paper on global environmental issues.

basic principle, while at the same time referring to the necessity of providing for intergenerational equity. The spatial equity issue, however, is not adequately dealt with and will undoubtedly need addressed in a subsequent protocol.

At the same time, there should be no *perception* of infringement of national sovereignty as part of the process, even if in reality some sovereign rights have to be given up. Sovereignty is reaffirmed as a guiding principle and the success of the conventions is made contingent on national enforcement. However, as we have seen, the Conventions limit sovereignty in various implicit ways, but evidently this has not been sufficient to deter most countries from signing the Conventions. Thus, Rio has had mixed success in framing politically acceptable rules.

Transparency

To be credible and to increase signatory confidence, any international arrangement has to be transparent, with actions under it open to scrutiny and debate. In the case of the Climate Change Convention, transparency is required in the accounting of GHG emissions, the steps taken to control them and evaluations of the efficacy of these steps. Mechanisms exist for review by the Conference of the Parties, and national inventories of GHGs and steps taken to address the problem have to be regularly published. The Biological Diversity Convention could face problems relating to transparency. The requirements of disclosure in the treaty are restricted to the country providing genetic material and the country receiving it in order to develop biotechnologies. This allows for situations where the country developing the biotechnology to exploit this asymmetry due to its stronger position with respect to information and resources.

Transparency is also essential in the working of the financial mechanisms that fund activities related to a Convention. In the case of the Conventions being examined here, the Global Environment Facility is the financial mechanism designated to effect the allocation and distribution of funds, on the condition that it be made transparent. It remains to be seen how this is done, because thus far, no details of how transparency will be brought about have been discussed in the document.

Issue Linkages

Issue linkages are considered essential in order to demonstrate the common advantage of adhering to a convention and later to a protocol to the different parties involved.[24] The history of negotiations relating to the 1958 LOS (Law of the Sea Conference) illustrated the necessity of establishing issue linkages. The package relating to the 1958 Convention envisaged three 'mini conventions' that dealt with specific issues. The disadvantage of such a process is that states can choose to adhere only to those conventions that leave them with a net advantage. This in turn leads to disagreement and confrontation and ultimately in the case of the 1958 LOS—to failure. For countries or groups of similar countries a single issue represents a clear gain or loss and therefore may prove non-negotiable, unless it can be combined with agreements on other issues that offset the losses. In the latter case, there may exist the possibility of an 'exchange' around issues for joint gain.

Issue linkages form part of both the conventions and also find a place in the Rio Declaration. To start with the latter, population is linked with production and consumption. On the one hand, developing countries have been concerned that their

[24]See Sebenius, 1991.

[2] Committee of Climate Change, National Research Council, 1989, *Global Change and Our Common Future*. Papers from a Forum. National Academy

high population growth rates should not bear primary responsibility for global environmental problems. On the other hand, developed countries are reluctant to accept changes in lifestyle patterns that would be made necessary if what has been described as their 'unsustainable' patterns of production and consumption are made the primary focus of environment and development problems. Principle 8 of the Declaration links the two in the following manner: in order to achieve 'sustainable development and improve the quality of life for all people' it recommends that states should reduce and eliminate unsustainable patterns of *production* while at the same time promoting appropriate *demographic* policies. This ensures that taking steps on both groups of activities become part of the agenda.

More specifically, in the two Conventions the transfers of technology and the provision of new and additional resources are promised in return for the fulfilment of commitments by developing countries. In the Biological Diversity Convention access to genetic material in linked to access to biotechnology by the country providing the resource. This linkage, however is inadequately dealt with in the Convention.

Conclusions

The international community can expect to see much negotiation and policy (both international and domestic) oriented activity that follows up on the areas implicated by Rio. One of the more obvious of these is that of negotiations for the development of protocols or other arrangements that will define clearly and put into practice actual instruments that will make the functioning of the conventions possible. These include, amongst others, areas such as equity determinations, emissions standards, the definition of new and agreed incremental costs, technology transfer and intellectual property rights and issues of liability and compensation.

A clear picture of the cumulative impact of the UNCED process will probably take years to come to light. The mechanisms that Rio has attempted to put in place are complex and are related to many different areas of international relations. The functioning of the global economy, lifestyles of people all over the world; the very process of development itself could conceivably see significant changes, even perhaps before the end of the decade. For this to happen, however, it is necessary that governments demonstrate a will to deal cooperatively with the issues involved.

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The Earth Summit—benchmark or non-event?

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Introduction

UNCED, 'Brazil 92', the Earth Summit—these were the words by which the UNCED (United Nations Conference on Environment and Development), decided upon by the United Nations General Assembly, was described, and which came to an end in June 1992. Its stated purpose, from the beginning, was clear enough. It was to confront seriously the impending ecological disaster, possibly even collapse, that the Earth was facing—on the one side by the uncontrolled development of the North and on the other, by two phenomena or factors for the South, one present, the other impending. The first factor was the ongoing and threatened pollution of the environment from its overwhelming poverty, accompanied by unbridled population growth. The second was that, if the South developed as the North has, there would result an unbearable addition to the toll on the Earth's resources and to its carrying capacity, as to spell disaster for all of us together. The Earth, after all, was the source of all resources, and the sink of all wastes.

The Conference was styled as being on environment and development. The means for attaining what was required for both these ware encased in the catch word popularised by the Brundland Report named after the Prime Minister of Norway who headed the Commission called 'sustainable development'. As if also to distinguish itself from the Stockholm Conference of 1973 on the Human Environment, the Earth Summit '92 was advertised as emphasizing development for the developing countries, as much as environment for all. Even in 1973, after a brief flirtation with the developing countries, in order to attract them to Stockholm, that (like labour intensive industries in economics) the poor countries would have a chance to attract 'pollution intensive' industries, the whole matter was set right when Indira Gandhi simply declared at that Conference that for the poor countries poverty was the greatest pollution, and development its sole answer. Thereafter UNEP (the United Nations Environment Programme) invented words like 'eco-development', giving a lot of satisfaction, though nobody clearly knew what it meant; and 'development without destruction', though there is never any development, let alone existence, without destruction[1], until Brundtland came along and said 'sustainable development'.

Even this last phrase, around which the entire Earth Summit was in fact drummed up, was without clear definition or methodology, too often, in practice, interpreted to mean the mere elimination of poverty for the poor countries, with no 'strategy' for real development alongside a sustainable environment. This indeed was the 'Achilles heel' of the Brundtland slogan of 'sustainable development', and held the seeds of the weakness of UNCED.

[1]In other contexts, this writer has quoted the 'trinity' of the Vedantic Reality as of 'Creation, Preservation and Destruction', as the Buddhist Doctrine of 'Impermanence', and the Gospel (of St. John) in which the seed must fall and be destroyed before it may live again.

Environmental equilibrium

For this type of higher level of development, which was also in economic and environmental equilibrium, means:

1. that rich countries had to redefine their life styles and consumption targets, and
2. that in their own interest as much as of the South, they had to make freely available their new environmental management technologies to the South in order to [a] contain the pollution accompanying rapid development; [b] maximise the use of alternative resources through invention, technology application, and various other means which only development could create.

Obviously, the North had not arrived at that point of being willing to talk on these positions whether at the Earth Summit or in the two years of the preparatory processes, that went before it. This was best seen at Rio, where of the two agendas essential to the Conference, namely, an 'Environmental Programme for Conservation' and an 'Environmental Programme for Development' only one was there, and the other was missing. The result was that UNCED became simply a matter of discussions and attempted conclusions on climate, on biodiversity, on forestry and so on, which, while in many parts highly commendable, were all in the group of what is best termed the 'qualitative' management of the environment namely the question of how to manage the enormously increased resources that the South would necessarily be using into the year 2000 and beyond, whether the North liked it or not.

Responsibilities

Surprisingly, the North was not the only party responsible. UNEP had, since Stockholm, build up a very responsible agenda, with delivery of results, on the qualitative side of environment, and had allowed the quantitative, development related, side, despite motions of studies on 'environment and development', to go completely by default. UNCED simply copied this, not able to show more creativity, even under the urging of its proclaimed conference title and its masthead of sustainable development. The poor countries of the South themselves compounded this failing of UNEP and UNCED in not emphasising the developmental aspects of 'sustainable development'. They did not clarify their position to the North, that they too would become developed countries, albeit over a period of time, but extending over large areas of the globe. In that event, while they would protect their own environments, they could not be expected to do likewise for the global environment, owing to limitations at their reosurces and technology. This would mean that, either the North see its 'own self interest' in global ecological security and lend its technological support to the South, or the world would go under. This is, indeed no idle future scenario. For, as that practical seer, Lee Kwan Yew expressed not long ago, enormous areas of the Asia-Pacific, including China and Indo-China, almost certainly India, and large areas of Latin America would arrive at this position.

This never figured at UNCED. Indeed, the South kept on asking at Rio for the traditional aid and trade concessions, which in any case they have been voicing at dozens of economic forums elsewhere. The results should have been predictable. The North which, at the first United Nations Development Decade of the sixties, almost agreed to 1 percent of GDP as its aid target, subsequently attained, and only in parts, a mere 0.7 per cent down the years. The offer now to reach up (even this without firm

commitment) to 0.7 per cent, made at the Earth Summit, is therefore no great success by any means to anybody[2].

As for the Conventions, UNEP itself under the persistent leadership of the professorial Mostapha Tolba, its Executive Director, had carried all these ideas and more, and even succeeded brilliantly in getting countries together—the latest example being the Montreal Convention. So in this way too, the Earth Summit simply did not score any great success. The point is, there was no need for an Earth Summit to do all this.

The conclusions

What then is left of it? Verbiage? Yes. Zeal and sentiment to groups and School generations? Yes. Chance of any real redress to ecological deterioration? Hardly any prospects yet.

Who is to blame? Apart from the secretariat, the North, primarily, had not given that lead in survival and growth together. The phrase 'environmental space' itself, by which the South sought to persuade the North was not a happy one. Both history and experience of environmental management had shown, if we cared to look at it, that it was not 'sharing' a 'fixed space', but vast increase of resources and enlargement of opportunities to all that served the peoples. This also created new 'technology', that then made continued management of the environment feasible.

As strongly pointed out earlier, the South's thinking on its strategy was itself totally wanting, by its failure to declare its position as one of rapid development, inviting the North to give or not give its response in such situation. In that event, 'lapse' meant accepting an ecological 'collapse'. Funding should have flowed implicitly from these positions and the acceptance of them as given. The principles following from them—and not the setting of target figures of percentages as Aid—would have yielded far better co-operation and collaboration between North and South.

People in their thousands would now have returned home from that Summit, clutching conventions which for the most part only the North can implement, and 'Action 21' (the agenda for the 21st century) carrying hopes without assurance of any fulfilment of them. Perhaps now the pieces need to be picked up. Quiet follow-up by the South and getting on with their development, with the North progressively facing up to the Earth's sustainability should perhaps be the next scenario. It is more than noteworthy that, amidst the outcries of the South, there were none heard from South Korea or (by proxy) from Taiwan. It is also noteworthy that Japan, whom everyone was turning to for aid was also another developing country within memory. These remain good lessons for the South to pick up and a good basis ultimately for a world that would be more co-operative in working together, and safer economically and environmentally.

Future

Thus the position was that the Earth Summit, billed as the world's largest conference so far, concluded with its outcomes inconclusive, but its message clear—that the poor

[2]It was a case of 'arguing' about the size of the zero, as Gamani Corea, the last Secretary-General of UNCTAD, told an Ambassador of the 'Group 77' at Rio on the morning of the final negotiating sessions.

countries must find their environmental solutions in the context of development, and not outside it.

It is now no more a question of how good 'Brazil' was, but of facing the future, into the year 2000 and the 21st Century. In that sense, the problems of the poor countries were not simply of global pollution and the 'global commons', though they were of serious concern to them, their solutions lying dominantly with the rich countries. The major problem of the poor countries was how to manage their resources of the environment, while pursuing growth that required massive increases in the use of these resources.

It was not just the elimination of poverty, which 'bred not only pollution, but also bred people'. Yet, the policy packages being used by the poor countries for environmental management were, unfortunately, the policy packages devised by the rich countries for themselves, and handed over by them. A new approach was necessary. At least, the thinking for that was available; and the future lay in that.

As for policy positions and strategies, the developing countries themselves, and not only the North, are standing environment 'on its head'. We all claim to be experts on environmental pollution and degradation. Nobody has answered the question how environmental resources management has to be handled in the factual situation, to which we pretend ignorance, of at least 5 to 10 times the resources that we are using, being needed, taking that convenient time post, by the year 2000, for minimum economic and welfare satisfactions of peoples (not reaching out to anything like the 20 or 40-fold standard of living of the North). Even that, former, more modest target requires,

(a) resource management techniques, of which the environmentalists are simply unaware now; and

(b) from the World Bank and the countries symbolised in it, a commitment to supply, not 'dirty' industries, but technology in range, scale and terms, to meet these needs, of which we have no signs yet.

Development should not be 'destruction'; and 'environment' should not be stagnation. In a felicitous phrase some years ago, the King of Thailand stated that 'Development is the creation of a liveable environment'. If the latter does not exist, then there has been either under-development or over-development; the former as much seen in the poverty of the poor countries, as in their international debts, inflations, and social deterioration; and the latter, in the environmental profligacy and planetary threat by the rich countries—as also, sadly, in an 'imitative' profligacy by the poor countries, typically in their urban enclaves.

UNCED, despite its verbiage, proceeded in ignorance of these needs in environment action or development cooperation. So much so, that while it provided a forum for loud Third World argumentation on their needs, it in fact had no agenda on them, but had, what we called, an agenda for instituting an 'environmental programme for consumption'. What had been left, at Brazil, was a swallowing of the West's prescriptions for environmental management, with all the attendant effects on poor country prospects and welfare—as, of course, longer-term ability to manage their own environmental resources.

The implication is that these peoples will be permanently ensconced in future stagnation and dependency on the rich, beside which past historical parallels of unequal relations, of colonisation, or of the 'gap', would each be a lesser phenomenon.

Policy issues

(i) The North

1. The issues before us were, and are, being presented, among others, as of one Earth, of global warning, the ozone layer, tropical forests, wild life, and the third world's population growth. It is that there is one environment, and one question, namely the threat of planetary collapse, or possible redemption by immediate action by all countries.
2. Yet the reality has been that while the Environment is a common concern of the North and the South, there were divergent perspectives. The North took the lead in identifying issues, but there were largely of little relevance to the South. On the other hand, the needs of the South were largely neglected in the policy framework of the North. These related to the eradication of poverty, and concessional access to technology, both for development, as well as for environmental protection.
3. In important ways, the North has by now developed an excellent environmental agenda for itself—on the one side, by internationalization of environmental costs, by increasingly impressive pollution control and treatment methods; and on the other, by visible re-cycling programmes and even if slowly, acceptance of limited air and water pollution. All this has been made possible only through a pervasive development of technology across all the areas of environmental management and economic production. For 'Development is not merely the cause of resource use, but also the means to resource sustenance'. (In the early seventies, a UK white paper had already been declared that development is the means in fact to solving most, if not all, of the environment problems themselves.)
4. To recall what all this adds up to is that, of the two types of management essential to a true environmental programme, only one, the 'qualitative' management of the environment was addressed by the North. The aspect of 'quantitative' management of its Environment has received little recognition and even less implementation—that is, both of excessive resource use by the 'North', and heavy resource need by the 'South'.
5. This means that the level of use of the world's resources by the 'North', by far the greatest user, has remained the same, and threatens to increase.

(ii) The South

1. Where do countries of the 'South' stand in this? By one extremely valid reckoning, that for the 'North', on an average, an individual uses/disposes as residues or wastes about 20–40 times that in the 'South', the population of Europe for example, 400 million is, 'environmentally' in fact, 8,000 million.
2. To stem the growth of population of some countries of the 'South', poverty, as we said, is not only a polluter, but a 'breeding ground' of people; and it is the 'mass' change (as opposed to 'marginal' change) of development that will, in fact, finally arrest population growth.
3. By way of comparison, too many countries of the 'North' have a higher density of population per square mile than the South, without at all attracting any policy structures. For when, during their industrial

revolutions, their populations spurted—picturesquely called 'the vertical invasion of the masses'—in Europe in the last century and around, their levels of resource use increased in parallel tremendously, by domestic exploitation and external expansion.

4. The almost explicit request to the 'South' now to use resources more modestly for development, emerges in this light as an 'asymmetrical' prescription from the 'North' to the 'South'. The international community completely overlooked the enormous question of the levels of resources use at both ends of the 'quantitative' side of environmental management.
5. Examples abound on the failure of this quantitative management in the North, are too many to list here. One estimate had it that the USA used 40% of the world's resources, with 6% of its population—it would have been more profound if it had attained its successes using only 6% of the world's resources. Another estimate was that if India used the same energy levels as the USA in its agriculture, all known oil reserves would be over in 12 years. And so on.
6. What remains the moral for us in this, both 'North' and 'South'? Again, we draw from our previous observations. The massive technological capability that the 'North' has developed for itself and continues to, in pollution control, treatment, re-cycling, alternative sources, and even stopping pollution at source, has placed it within sight of warding off a global environmental cataclysm.
7. However, this has a premise. Namely, given little Northern intentions to share technology or money, the South does not use the same, or anything like the resources in 'replaceable development', as the North is continuing to do. For, then, the World would certainly collapse environmentally on both accounts, namely (a) the vast new mass of resource use levels; and (b) on a base of environmental management technology that is primitive and totally insufficient. The apocalypse then, would be for sure. The Agenda of the 'North' is based on this unspoken premise, and the appurtenant theory of the Apocalypse.
8. This is the crux, containing the two 'problematiques' of Environment and Development, whose 'intersections'to use the phrase of Ph. de Seynes, former USG of the United Nations, are still to be found. And this, was not in the Agenda of 'Brazil 92'.
9. The 'South' needs, as we said, on a modest estimate, at least 5–10 times the resources it is using now for development, and for environment. Thus, the 'South's environmental priority at Brazil was not less resources, but far more resources than now.

Measures

1. How may this be achieved and the earth too kept in ecological balance?
2. Firstly, an ideal is for the North to come forward to participate in a research use containment programme for itself, apart from all other current agenda.
3. The context for this is that very significant areas of the 'South', by the year 2000 or there at, will surge forward as developed countries, with enormous additions to the World's resource use levels, whoever likes it or not. When that happens, the global Environment at the given levels of technology will become unmanageable.

4. Left in that situation, pollution on large scale will occur, until these countries too become fully developed; and can use those technologies that will manage, contain and solve the problems of the environment alongside growth unless, well before that stage, the world environment itself collapses; or unless the 'North' brings down its technology and resources to the 'South'.
5. It is, thus, more than a question of what we are prepared to 'give' as donors, or 'do' as receivers; or 'bargaining' on either. In the compulsive future that will evolve, there must occur a massive use of resources and massive development all over, if we go in one way, with safeguard to the Earth and to world order; if in another, with cataclysm and conflict.
6. The 'contribution' to co-operation needs, therefore, to be seen not as aid, but as 'own self interest' and as global contribution to the global eco-system, outside the economic aid and assistance frameworks that we see entrenched now.
7. Such an agenda, given good sense, had to be found place in Brazil, with vision into the year 2000 and beyond; but was not.
8. If these may become so, then a set of (a) principles, (b) programmes, and (c) special activities can be seen as below, which must, in one way or another, be adopted.

Principles

(i) recognise the historical ' asymmetry' in resource use levels as countries struggle to become developed.
(ii) agree that development is the means ultimately to commanding the Resources and the Technology for the same environmental threats that Development and, before, poverty created.
(iii) agree that the 'North' will increasingly set resource use limitation targets for itself.
(iv) agree to set out appropriate resource use expansion targets for the 'South'.
(v) accept that development, in the striking phrase of the King of Thailand, is 'the creation of a liveable environment'.
(vi) reject the 'consumerist, mercantilist and commercial' type of development as manifest in many cities/enclaves in the South passing off for development.
(vii) agree to a set technology supply/transfer targets from the 'North' and financial resources for successful environmental management in the 'South'.
(viii) agree to set global pollution control targets, for 'North' and 'South' as appropriate.
(ix) accept the setting of consumption targets for select resources, such as tropical forests, genetic resources and other select renewable and non-renewable resources.
(x) in that connection accept the relevance of the 'polluter pays principle', also at international level.
(xi) commit to the support of resource 'expansion' targets as set out, using combination of technology with Restoration, and maintenance methods, the use of renewable and reusable resources and wastes, and search for alternative, 'friendly' sources, in all areas.

Programmes

(i) Establish 'resources balance sheets'—global, regional, sub–regional, national—or all major resources (macro-level; ex-ante)

(ii) Account all key natural resources as 'capital stock', with provision for depreciation, re-equipment etc; and with 'reverse discounting' in strategic cases.

(iii) Conduct EIAs (the micro-level; ex-ante) only on the basis of prior resource balance sheets as above.

(iv) On the basis of the above, move towards converting all EISs into Integrated Environment/Economic Cost-Benefit Systems, fully integrating all costs and all benefits.

(v) The 'North' to take technological/financial responsibility (with 'South' co-operating) for Global Warming (CO_2, Sea Level rise, Ozone, CFC and other issues of the Global Commons.

(vi) All projects in the South using renewable or re-usable resources and wastes to be eligible for grants/low interest loans from the International lending countries and sources.

(vii) Implementation of an international polluter pays principle ('cost sharing') for the world's tropical forests (as its 'carbon sinks'), genetic Resources Conservation and related areas.

(viii) Accept and foster the UN initatives for establishing expanded Environment-Economic SNAs (mcro–ex-post).

(ix) Accept and foster the development and use by enterprises, agencies and others concerned, of Environmental ('green') audits, which are also development 'sensitive' (micro–x-post).

(x) Subject to the foregoing, the 'South' to be fully responsible for all degradation/pollution during its development, as its commitment to the global eco-system, and to itself.

Special activities (academic, research, etc.)

(i) Vast fields of study await attention of the world's universities, institutes and other centres, in all sectors—in ideas (e.g. the future of city planning, transport and the motor car); in science research (e.g. as energy alternatives, pollution prevention, bio-technology); and in across the board technology development promoting both the economy and environment.

(ii) Socio-political fields need fundamental thinking on policies, administration and systems, with need for distinction between 'protectionist' and 'productionist' approaches. Legislation must distinguish between enforcing the law on poor polluters of wastes, and enforcing system for their 'conversion', by governments and agencies, into economic product ('from being a residue to be disposed of, to a resource to be converted').

(iii) The entire education content of environment management needs fundamental re-arrangement, from pure pollution orientation to resource restoration, management and use.

(iv) The world's NGOs have a particular function and capacity in all these to help environmentalists and governments to do their 'home work', and (b) to 'speak for the grass roots and intercede with authority on the one hand; and to interpret the government to the grass—roots on the other'.

(v) A 'new economics' absorbing environmental resources management, awaits formulation out of the foregoing thinking, with no room by either discipline to conceive of themselves as 'opposites'.
Over the decades, economics has, in fact, absorbed 'on-economic categories' in the past; and will do so again, given effort by the environmentalists, to go beyond the 'slogan' of sustainable development, to the methodology of 'sustained Maintenance of future resources levels' called for above.

(vi) A Draft Convention, embodying commitments on the foregoing, would have been a truly appropriate contribution from Brazil '92, for the future peace and welfare of the planet. The difference between prosperity for all, and disaster must lie in the ideas presented here. Not accidentally, they seem fully in accord with the call by the US President at a Post-Iraq declaration, for a New World Order, as he puts it, in 'a partnership united by principle ... and supported by ... equitable sharing, of ... cost and commitment'. Since well forgotten it seems, it is still capable of recall.

Regional co-operation

(i) The scope for regional co-operation and capacity building for sustainable development, including a possible 'Compact' for sustainable development in Asia, has rightly been raised as a policy instrument.

(ii) This paper does not go into their specifics, since the organizers of this meeting have proposed to place a Draft Compact themselves. However, certain select substantive points may be flagged below.

(iii) At least two major areas of key importance must be noted:
(a) The first is the need for positive and innovative designs, at macro–and micro–levels, for integrating environment and development.
Obviously research at University levels, sadly deficient, or superficial, or segmented if in-depth, has to be pursued intensively, as well as priorities in education and training. (b) Secondly, the development of indigenous environmental technologies must be given top-most priority. Energy remains a key element, but the technology priority should obtain for all areas and all related disciplines.

(iv) Both these require, without doubt, the ingredients of sensible, professional and co-ordinate Regional co-operation mechanisms.

(v) Across the broad co-operation by Governments, United Nations bodies covering Asia and, in particular, the Asian Development Bank, must be forged, and be forthcoming.

(vi) At the level of Inter-Governmental Organisations, ASEAN and the South Pacific Forum have successful environmental Co-operation Organizations (ASEP and SPREP).

(vii) For South Asia, the most obvious thing to do is to give political support to the full use of what is known as the South Asia Co-operative Environment Programme (SACEP), established in February 1981, as the Inter-Governmental Organisation for this region. (All these incidentally were initiated by this writer during the Seventies and the turn of the Eighties from the United Nations.)

(viii) Yet, the South Asian countries themselves have been forgetting their first lessons in co-operation by initiating somewhat confused parallel programmes in SAARC, which obviously has its own separate rationale and high purpose over-all.

Fortunately, the most recent Governing Council of SACEP held in Colombo this year, inaugurated by the President of Sri Lanka, himself one of the prime movers of SACEP in 1981 and current Chairman of SAARC, emphasised the unique role of SACEP as the basis for South Asia's future environment. If the countries were to become serious about co-operating with their own mechanism and its goals, then the next steps may not be considered problematic.

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Annexes[3]

In a climate of much emotion and generalisation, and confrontation between Development and Environment, this Document sets out, as Annexes, a set of practical designs in the following matters.

(1) An operational Framework on 'Environmental Designs and Policies'.

(2) A brief schematic display of Macro Level (ex-Ante) Resource Management under 'Resource Balance Sheet' exercises showing also its link to the next Micro (ex-Ante) projects assessment stage.

(3) The Micro (ex-Ante) presentation of an 'Integrated Economic-Environment Cost-Benefit Presentation', as above.

(4) An 'alert', drawing attention to the new Macro (ex-Post) Satellite System of Integrated Environmental and Economic Accounting (SEEA). This is not presented here, as the best reference is the excellent work already initiated within the United Nations, at New York.

(5) A Framework Presentation of the components of Micro Level(ex-Post) Environmental ('Green') Audit requirements for major production areas such as firms, agencies and others.

(6) Purely as going beyond 'lip service', an Urban Traffic Design of a City without the use of cars is presented, called 'Pedestrapolis - Future City' (in the words of Carlo Ripa di Meana, Environment Secretary of EEC, making it a case of 'car free cities, also a lot cheaper').

[3]The Documents mentioned above are not attached hereto, but are available for reference.

Sustainable development and the evolution of international policy and law

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The full meaning of the term 'sustainable development' is yet to revolve and the path to its attainment is not clear as yet. The term will evolve in multilateral fora, as it is no longer possible for a country to formulate an appropriate environmental or economic policy entirely on its own. The success of UNCED (United Nations Conference on Environment and Development), held at Rio de Janeiro, in June 1992, has initiated a process between interaction between States characterised by interdependence, converging objectives and global integration. The subordination of internal processes to the interactive processes of nations will lead to a formal structure to the global partnership based on shared values relating to the natural environment, its use and maintenance. The challenge will be to link environment and development so as to channel the forces of change in a manner that improves living standards in the developing countries.

This paper seeks to trace the impact of the UNCED on the evolution of international policy and law. The first part specifies the factors providing for global integration. In the second part, the factors dividing developing and developed countries are analysed. The third part indicates the options and the growing importance of multilateral, regional and intergovernmental institutions. The assessment is made on the basis of available evidence and judgement, the decisions will be taken by States.

Global integration: common concerns

The significance of Rio for environmental policy and law is the universal recognition that environmental quality, as an essential life support system, is a common concern not more important than national interests but that it is important to national interests. Three approaches for operationalising global integration are already becoming apparent; for integrating societies, peoples, policies and states.

First, the Rio Declaration on Environment and Development and the Conventions signed at Rio have emphasised the eradication of poverty as a prerequisite for safeguarding environmental quality for future generations, blurring the existing separation of economic and political issues in international relations. Converting this statement of values for sharing global prosperity, into norms and obligations will be a key element in securing the continuing commitment of all States to common values; because of the ensuring benefits in terms of providing services, increasing options and enhancing capabilities.

Second, considerations of environmental quality provide a process of global interaction opposed to the current philosophy of the international economic system and its assumptions informing economic policy, where costs to the environment are externalized. This common concern, based on the environment rather than on function or territory, provides a new role for multilateral diplomacy in adjusting interests among, but also within, groups; reducing the possibility that solutions are affected by differences in political and economic strengths of the parties; underlining the equality and interdependence of states in the international systems; and, identifying the opportunities for improvement through market instruments.

Third, the States have voluntarily accepted a new kind of central authority, the Commission on Sustainable Development as well as Subsidiary Bodies on Implementation in the Conventions signed at Rio, to review the programmes for sustainable development. These institutions have specific functions that go beyond the purely technical and specialized nature of tasks, which characterises existing international organizations. Their mandate includes controversial political areas that are inherently 'expansive', as they recognise 'joint decisions' and 'delegation' of decision-making to the new organs; which are permitted to promulgate guidelines and channel benefits. This common purpose constitutes a significant step in the cumulative process of change in the nature of relations between States towards global integration.

The priority allotted to specific global environmental problems and goals, the methods for achieving these goals and the pace of fulfilment will vary in different national settings, as the costs of protecting the environment relative to other priorities vary across countries. A balance would need to be struck between precautionary action for long-term environmental protection and the immediate requirement of survival facing the majority of the world's population, and their need for capacity building to increase options.

Definition

In defining sustainable development a distinction needs to be made between its objectives, normative and procedural components. The objectives component is the composition, structure and distribution of ecosystems which affects the ways in which they exchange energy and materials. The normative component is the judgement on the 'desirable' combinations of consumption patterns and productive technologies that will be based on an understanding of the scientific assessment and social conditions, which will inturn determine the strategy that will be acceptable, and to what extend. The procedural component includes requirements like transparency, capacity building, people centredness and participation.

Sustainable development links environmental, technological and social concerns into the economic decision-making process of the market. In determining the relative importance, in human-nature interactions, to be given to precautionary measures or to capacity building, some key issues are going to dominate future negotiations on the character and distribution of economic growth.

Regimes related to environment, development, aid and trade will no longer be developed in isolation from each other. At the international level, institutional arrangements for coordination of policies, guidelines for the use of various economic instruments, indicators for measuring performance and procedures for sharing information and resolving disputes will emerge to achieve a balance of interests between countries. At the national level, technologies to be adopted reflected in capacity building to identify sectoral strategies, as well as measures, priorities and investment opportunities for the transition to sustainable development, will become the focus of national planning. The procedures and character of bilateral, as well as multilateral, assistance will change to encourage private sector investment and technology flows.

There will be greater interaction between the organs of the United Nations and the Bretton Woods system. Their role will shift from a purely technical one to that of 'bridging institutions' to harmonise and promote economic activities across countries.

The multilateral negotiating process will increase the chances of finding solutions acceptable to all affected parties.

Elements

The Rio Declaration clarifies as well as further defines the concept of sustainable development. It includes elements regarding state responsibility for the well being of its citizens and harm caused by them to the environment; in striking a balance between the two it recognises the primacy of development.

The Stockholm Declaration, while bringing environment onto the international political agenda, did not say anything how the aims were to be achieved; the Rio Declaration introduces priorities and procedural requirements for operationalising the concept of sustainable development and goes beyond looking at technological solutions to environmental problems. The Rio Declaration shifts the international focus from conservation to contamination; from identifying limits of natural resources to determining sink constraints of the environment; and, from supply to demand related issues.

The Rio Declaration on Environment and Development, unlike the Stockholm Declaration on the Human Environment, attaches greater importance to the social over the physical environment. Principle 21 of the Stockholm Declaration, which is the only principle recognised as soft law, has been amended by stipulating that States have a right to exploit their own resources pursuant to their own environmental and developmental policies. The additional reflects the recognition that development must not be constrained by the generalised rules of international law for the environment. This principle, along with the addition, has been incorporated in the Framework Convention on Climate Change, giving it a wider legal validity and acceptance.

The Rio Declaration achieves a balance between the substantive requirements of sustainable development and the procedural requirements for implementing environmental protection. In relations between States the Declaration recognises:

[1] human beings as at the centre of concerns;
[2] right to development;
[3] environmental protection as an integral part of the development process;
[4] eradicating poverty as an indispensable requirement for sustainable development.

The Declaration also requires States to adopt certain procedures to ensure environmental considerations are integrated into decision making:

[1] effective environmental legislation;
[2] public participation in environmental decision making;
[3] application of the precautionary approach;
[4] promotion of the polluter pays principle;
[5] adoption of environmental impact assessment;
[6] notification in the case of emergencies and activities with significant transboundary effect.

Elements of international cooperation for sustainable development, for the first time in international environmental negotiations focusing on economic issues, are also laid out to:

[1] decrease disparities in the standard of living;
[2] strengthen endogenous capacity building by improving scientific understanding and transfer of technology;
[3] promote a supportive and open international economic system;

[4] prevent the transfer of harmful activities and substances;
[5] develop a legal liability regime as a transboundary regulatory instrument.

The Declaration envisages a 'global partnership' to not only conserve and protect but also restore the 'integrity and health of the Earth's ecosystem', through five steps :

[1] reduce and eliminate unsustainable patterns of production and consumption;
[2] promote appropriate demographic policies;
[3] exchange scientific and technical knowledge;
[4] enhance the development, adaptation, diffusion and transfer of new and innovative technologies; and
[5] promote a supportive and open international economic system.

Principles of the Declaration relating on the one hand to the right to (sustainable) development and priority to the eradication of poverty and on the other hand to adopting precautionary measures and environmental impact assessment have been incorporated into the Framework Convention on Climate Change and the Convention for Conservation of Biological Diversity. This has made them a part of international law. Policies fleshing out these legal principles will follow two parallel tracks.

First, the Rio Declaration achieves a balance between the obligations accepted by the developing countries to prevent further deterioration of the environment and the responsibilities of the developed countries for causing the damage. The principle of common but differentiated responsibility for global environmental degradation has been accepted, with the developed countries acknowledging their responsibility 'in view of the pressures their societies place on the global environment and of the technologies and financial resources they command'. The case has been made for transfer of resources and technology based on the advantages that have accrued to developed countries and not on purely altruistic considerations.

Second, while the Stockholm Declaration was concerned with the conflict between the sustainable use of natural resources and transboundary pollution, twenty years later the understanding of both the content and the context of the human interference with the ecosystem has changed. The policy focus is no longer the apprehension that environmental considerations will restrict the right of States to exploit their natural resources, but the impact on sovereignty of restrictions over activities affecting the natural environment. With this widening of the scope of agreed restrictions, sovereignty is acquiring a new meaning.

The significance of the Rio Declaration lies in its requirement that for the fulfilment of its principles, the further development of international law in the field of sustainable development, not only in the field of environment, is needed. The policy focus now is on the content and pattern of economic growth itself.

The future debate for implementing sustainable development will be on the relative importance of production or consumption activities in the measures for reducing contamination, the approach to risk management, and equity considerations.

Measures

The convergence of four major themes, with conflicting but related measures, will dominate international relations as countries seek the transition to sustainable development:

[1] safeguards for the geophysical degradation of the environment and its continued use as a sink, a balance between disposal of hazardous substances and activities related to forests;

[2] changing consumption patterns and eradication of poverty, in the context of the relative importance to be given to local or global environmental concerns;

[3] transfer of financial resources to compensate and assist developing countries, incorporating new arrangements involving multilateral organizations, non-governmental organizations and transnational corporations in aid flows; and

[4] the use of trade measures to influence environmental policies in other countries, involving of interventions ranging from transfer of environmentally sound technologies to new barriers being erected against imports produced under less strict standards.

Despite the intrinsically domestic character of the problem and the policy choices to be made, environmental issues have become internationalized because of the irreversible nature of the changes in the environment, and the need to adopt precautionary measures.

Global conflict: determining priorities

The issues that will divide developing and developed countries is the emerging concept distinguishing local and global concerns related to impacts, benefits and resources. The issue of determining priorities for action was left unresolved at Rio.

With the tightening of global environmental controls, the local economic implications, both in social terms for meeting developmental needs and in terms of determining costs in a highly competitive global marketplace, become issues of concern. Incremental costs incurred by developing countries for global environmental considerations are being defined only as that part of the expenditure that is not offset by nationally appropriated benefits, which could impose a greater burden than is warranted by their contribution to the problem. Environmental considerations are sought to be incorporated into development strategies, but external assistance is largely limited to capacity building for evolving strategies, preparing investment projects and building awareness. National resources, like forests, that have global significance are being treated as shared resources, for whose management all States have a joint responsibility. The argument being made is that global concerns require policies to be made at the global level, but increased resources must largely be generated from within States.

Global environmental pollution cannot be dealt with without tackling its national origins. At Rio, despite the acceptance by developing countries of problems of global pollution, developed countries avoided any commitments towards increasing ODA (Overseas Development Assistance) for so-called 'local' problems related to poverty; or, even problems for dealing with local pollution, like sewage treatment. Arrangements for global integration will not have the support of citizens in developing countries unless they first establish and safeguard equity considerations.

Since global concerns will come to be regulated by international institutional mechanisms, the prioritization of concerns will globalise economic policymaking. This will influence national development priorities through the assistance, on grant or concessional terms, provided by the Global Environment Facility. The mechanism will be National Reports, which have now become a feature of all international environmental agreements. Global policies will emerge in the fields of energy, agriculture, forests, trade, debt and technology transfer as these activities have led to

environmentally damaging behaviour. Similarly there will be multilaterally agreed rules to guide countries in formulating their own environmental policies. As these policies will evolve in inter-governmental forums, they will incorporate the concerns of all States.

Implementation will require institutional reform, including that of national policy institutions, to reach agreement about solutions which carry high social costs, whether in terms of future benefits foregone or present benefits given up. Tension will remain as long as there are large disparities in standards of living, and the eradication of poverty is not recognised as a 'common concern'.

Agenda

The agenda for sharing responsibility and prosperity will be set by the way issues are defined. Since the stress will be on preventive action, a scientific consensus will precede negotiations of a more overtly political—economic character. Preparatory meetings will assume greater importance, with the policy sciences increasingly becoming more consequential than the social and physical sciences.

This trend will be paralleled by two developments. First, debates on the composition of the scientific bodies to have experts, and not representatives of governments; and, with these bodies, whether to give stress to econometrics or sociology. Second, the separation of data generation from data interpretation; the former will increasingly come under the purview of UN bodies, like UNEP, and for the latter a greater role will devolve on international non-governmental organizations and trans-national corporations. The role of scientists, non-governmental organizations and corporations in determining policy will become more important.

The agenda for sharing global prosperity will not be formally negotiated, and will need to be introduced by the developing countries during the discussions. The most appropriate forum would be in the development of international environmental law, through a legal liability regime. The ongoing process in the International Law Commission would need to be given direction.

Options: global and national

In the globalization of environmental policy governments will not be the sole actors; their role will gradually be limited to implementing a set of internationally agreed measures.

Participation will take on a new meaning. On the one hand, at the international level the scale of involvement of (international) non-governmental organizations in international negotiations will grow, giving formal recognition to their guardianship-type role. On the other hand, within nations, the role of governments will be pivotal, with a new lease of life for central planning. The policymaker will be required to take into account an overview of the whole economy. The balance of costs and benefits to the economy will depend heavily on externalities; the externalities will require a weighing of social, rather than private costs and benefits. It will be important that these judgements are made by decision-makers accountable to an electorate, leading to greater community participation in decision-making.

The tensions between governments accountable to an electorate and non-governmental organizations committed to a cause, over agreement on facts, the significance of particular facts, value judgements and interpretation of evidence, coupled with scientific uncertainty, will open up spaces for conflict over interpretation.

This will lead to the setting up of multilateral arrangements for dispute settlement, which will give international non-governmental organizations an almost equal status as States.

Policy

The risk and the distant time horizon of policy will call for an explicit or implicit role of governments in the removal of subsidies in the use and exploitation of natural resources as well as financing new infrastructure, including research. Transportation will be a major sector of concern; for developed countries the focus will be on user-charges for roads and for developing countries on affordable mass transportation systems. The second sector will be energy, where nuclear power will gain greater attention world-wide. The third sector will be agriculture, with biotechnology leading to specialization and increases in productivity across geographical regions with a reduced dependence on chemical fertilisers, pesticides, and water. The impact of these technologies on the ecosystem will still be there; carbon dioxide and hazardous chemicals will be replaced by radioactive waste and genetically modified organisms; in lesser quantities but with environmental contamination which could be irreversible, without reducing the dependence on the use of natural resources.

Institutional reform within nations, for building domestic consensus about relevant problems and proposed solutions, will facilitate consensus in, and development of international regimes. The three key problems are lack of policy integration (reflecting the systemic and interdependent nature of the problem), strategic knowledge (assessment of long term trends, risks and options) and public participation in decision-making. Consultative processes, both inter-governmental and national, will be set up for determining priorities.

Economy

The central concern for environmental management will be agreeing on certain values; that the limits to growth are social, as well as environmental. Economic activity means using up natural resources, including the sink constraints of the atmosphere; recent scientific findings even link climate with the origins of biodiversity. On the one hand economic growth enriches society, and enables investment in cleaning up pollution. On the other hand, though the technology uses less resources, effects can be nullified if consumption is not curtailed, including stabilisation of population. With still too many poor people, continuing growth in only one part of the world is unfair to future generations in the other.

Consequently, the responses will differ. In the developed countries, policies to produce a steady-state economy will be considered; while in the developing countries the policy debate will be on how to increase options. The debate will take on philosophical undertones—does growth lead to greater happiness? Should, or can, economic growth go on far ever? A consensus will take time, but these questions will be asked with increasing frequency.

The structure and rules governing international trade are being re-examined to harmonise environment and trade. At the international level the debate will be whether trade liberalisation helps or hinders environmental protection, the role of appropriate domestic environmental policies in the process, and the degree to which jurisdiction should be asserted over other nations' environmental priorities and practices. The primary question in the debate is no longer 'efficiency' but 'enforcement'. GATT

(General Agreement on Tariffs and Trade) is likely to be used to take authority away from national governments for setting environmental standards. Simultaneously, it is also likely that agreement will be reached that international treaties on environmental resource management should take precedence over GATT. The result will be that unilateral action to influence environmental policies by reducing access to markets will be replaced by negotiated guidelines for an international agreement on standards.

Technology

The substantive issues in the evolution of the 'new' values for sharing prosperity will be to consider environmentally sound technology as a shared resource, and not as private property. The methology for the transfer of environmentally (safe and) sound technologies will continue to be debated, purchases to place technologies in the public domain, subsidy for particular equipment, assistance for research and development and dilution of patent regimes or investments of transnational corporations will be some of the options to be considered. Prolonged negotiations can be expected in the Framework Convention on Climate Change, Convention for the Conservation of Biodiversity and the General Agreement on Tariffs and Trade; as well as in the United Nations General Assembly.

Burden sharing

At the heart of the debate is the issue of who should pay for cleaning up existing environmental damage, and for ensuring that further damage does not occur. The inter-relation of economic policies and technologies will become important as these affect the incremental costs to developing countries, which developed countries have agreed to meet. Implementation of this concept will follow two tracks. First, the definition of 'technology transfer' will be expanded to include supportive policies and investment opportunities. Second, developed countries will aggressively seek markets in the developing countries to implement the programmes of Agenda 21; Japan is likely to take the lead with the thrust on technology diffusion and joint research with institutions in developing countries.

The widespread adoption of 'clean' technologies of production will conserve resources, use less energy and produce low quantities of waste. Capacity building will, therefore, need to be the key element for these transactions to become a part of the global partnership, agreed to in Rio.

Targets

Within this framework, negotiations will revolve around the determination of comparable methologies, performance standards and targets affecting policies for economic growth and environmental protection. The trend towards greater globalisation will be reflected in the setting of common standards for pollutants, methologies for monitoring and data analysis in the various national reports, criteria for determining costs of environmental improvement, parameters for evaluating sustainable development policies and identification of technologies for the programmes and projects. Economic instruments for determining policies will include both supply and demand considerations and the valuation of environmental services.

The nature of the targets will determine the content (sharing responsibility or prosperity) as well as the mechanism (verifying prohibitions or developing capacity building) for the arrangements at the international level, for facilitating the transition to

sustainable development. In this process international organizations will take on a more proactive role.

Institutions

The institutions set up at the international level will increasingly take on a legislative character, with the international bureaucracy carrying out tasks at present performed nationally. The challenge will be regards sensitivity to national concerns, transparency and playing a facilitative role in capacity building.

With increasing interdependence and flow of benefits, special majorities, in place of unanimity, will gradually become acceptable for an increasingly larger number of issues. In the redefinition of sovereignty the scope of 'shared natural resources' will expand to include forests, water and even soil. Monitoring will increasingly become networked through computers and satellites; and less intrusive. With the end of the Cold War, high resolution military satellites will increasingly be used for environmental monitoring.

Differences will arise on the applicability of international law to particular situations. Guidelines, rules, and precedents, will give rise to issues of interpretation, especially in the relatively new area of concern relating to standards of living and production and consumption patterns. The issues are among the most sensitive in any society, where scientific understanding also comes down to a matter of subjective judgement. Even fair minded individuals, however well informed, can differ substantively on where to strike the balance. Adjudication on points of interpretation, as well as disputes, will become acceptable as they will be taken in multilateral fora.

Regional groups

The trend towards the globalisation of environmental, aid and trade policy-making will increasingly be inter-related and integrated through the harmonisation of standards; a parallel trend will be the emergence of regional blocks. Three developments will follow.

First, with the worldwide decline of the public sector, the initiative will be taken by the private sector to develop new markets, particularly in the services, information, communication, power, sewage treatment and hazardous substances treatment sectors; trade and investment patterns will determine the common environmental standards within regional blocks.

Second, issues particularly regarding who will pay the developing countries for much of their environmental activities, will oscillate between whether market based mechanisms should depend on prices (charges, taxes, or subsidies) or on quantities (tradeable permits); as well as between multilateral and regional forums; options will be reduced for those countries who are not part of regional arrangements. The Framework Convention on Climate Change recognises joint implementation of commitments.

Third, regional groups based on shared natural resources, with liberalised trade and investment will produce the financial resources for environmental improvements as well as in standards of living. The Convention on Conservation of Biological Diversity recognised the need to value biodiversity and to share the profits of its commercial exploitation.

Policy problems will appear in valuing goods and services outside the market economy, which are a feature in developing countries. New economic policy

instruments will also need to be developed that recognise explicitly social and environmental factors in the way costs and benefits are defined.

If the investments lead to a rise in general standards of living, international diplomacy will gradually shift the focus of multilateral negotiations from transfer of resources to public health concerns, reflecting a common global environmental priority; otherwise, claims over the use of environment will lead to conflict.

Cooperation

The integrating theme for international cooperation will be provided by negotiations on debt reduction, implemented through at least three mechanisms related to the use and distribution of natural resources—debt for nature swaps, emissions trading and technology diffusion. The key actors will be the major groups UNCED, non-governmental organizations and transnational corporations. Key institutions will be GEF (Global Environment Facility), GATT and SDC (Sustainable Development Commission on the UN), for recommending policies, enforcement and review of sustainable development, respectively.

Developing countries

These trends provide both possibilities and options to developing countries. Their ability to shape events to their advantage will depend primarily on their adopting a new development paradigm based on sustainable values, through changes made in internal policies for greater equity to better manage the local environment; and the extent to which they can restrain the growth of consumption without affecting social development. The challenge for developing countries will be in using the increased flow of assistance for capacity building and not consumption.

The evolution of regional blocks will provide increased options to developing countries. Negotiating coalitions will form around specific issues, which will be another factor pushing countries into regional blocks. Present patterns of resource use, where one-quarter of the world's population uses three-quarters of the resources will change in the process as free-trade areas develop, facilitating the flows of technology and investment. The development of regional blocks, consisting of countries at various stages of development, will be a significant outcome of the global transition to sustainable development.

These developments will affect the pattern of relationships within the G-77 grouping of developing nations, which so effectively dominated the Preparatory Committee and shaped the outcome of the Rio Conference. Just as the categorisation of developed countries now includes 'Economies in Transition', groupings of developing countries, like the Non-aligned Movement, will take up economic issues, eventually focusing on sustainable development.

The next steps

The distinction between developed and developing countries, which is based in terms of material consumption, will soon become blurred. Natural resource accounting will replace gross national product as the measure of identifying and valuing environmental effects of economic activities, economic output, social welfare and ecological sustainability. Sustainable development will then achieve greater clarity, while allowing flexibility and diversity in approaches for its implementation.

Conclusion

The evolution of the concept of sustainable development has been based on consideration of the part of the policy process being addressed. Stockholm, in 1972, was concerned with specifying the casuality and significance of the problem. Rio, in 1992, dealt with assessing options for action. The next conference will make and implement decisions.

The implications of Agenda 21—an overview

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Introduction

The UN Conference on Environment and Development (UNCED) held in Rio de Janeiro from 3-14 June 1992 was an important milestone in international cooperation to tackle environment and development issues. While the 1972 Stockholm Conference on the Human Environment initiated global awareness about environmental issues, UNCED affirmed the importance of the twin issues of environment and development being addressed in a balanced and comprehensive manner. As a result of UNCED, the protection of the environment has been accepted as being inseparably linked to the promotion of development and has emerged as one of the few areas where a meaningful North-South economic dialogue is in progress.

Perhaps the most important operational output of UNCED was the agreement reached on Agenda 21. While Agenda 21 is not legally binding, its endorsement by more than 180 countries, of which over a hundred were represented at Rio at the level of Heads of State/Government, clearly reflects the importance assigned to it by the global community and the high level political commitment to its contents.

Preamble: political aspects

The overall focus and sense of direction to Agenda 21 is provided by its carefully negotiated Preamble, which constitutes the first of its 40 chapters. The Preamble specifies that the integration of environment and development concerns and the devotion of greater attention to them will lead to the fulfilment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. It emphasises that nations acting alone cannot achieve this objective. They can, however, do so through a global partnership which builds upon the premises of UNGA Resolution 44/228 of 22 December 1989 and the acceptance of the need for a balanced and integrated approach to environment and development. While stressing that the successful implementation of Agenda 21 is 'first and foremost' the responsibility of governments, the Preamble also states unambiguously that international cooperation should 'support and supplement' rather than seek to supplant national efforts.

To achieve the development and environment objectives of Agenda 21, the DCs will require a substantial flow of 'new and additional' financial resources to cover the incremental costs of their actions to deal with global environmental problems and to accelerate sustainable development. This crucially important reference for DCs has been deliberately included in the Preamble. Following intense negotiations, a secondary reference has consciously been given to the economies in transition, with the Preamble acknowledging in a subsequent paragraph that 'special attention' should be given to their particular circumstances.

The entire text of Agenda 21 was negotiated during the UNCED process and it thus reflects the agreements reached amongst participating States. The Preamble, however, makes clear that Agenda 21 is a 'dynamic' programme which could 'evolve over time' in the light of changing needs and circumstances. Moreover, the Preamble

recognises that Agenda 21 will be carried out by the various actors 'according to the different situations, capacities and priorities of countries and regions'. These inclusions, which provide the necessary flexibility, also allow for a subsequent review of Agenda 21, and are important since Agenda 21 addresses not only the pressing problems of the day but also aims at preparing the world for the challenges of the next century.

It is of interest that the term 'sustainable development', though widely used, has not been defined either in Agenda 21 or in any of the other texts emerging from UNCED. Nor was any serious attempt made during the negotiations to work out such a definition. The meaning of 'sustainable development' could, however, be distilled in many instances from the context in which the term is used as the link between environment and development—the twin concerns of UNCED, the essence of the concept of sustainable development, however, lies in the process of improvement of the quality of human life, doing so within the carrying capacity of supporting ecosystems.

Preamble: economic aspects

The Preamble demarcates sustainable development concerns. These include intra- and international equity, 'poverty, hunger, ill-health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being. The ecosystem is accordingly, viewed in strictly anthropocentric terms, a position also unambiguously articulated in the Rio Declaration on Environment and Development. While fulfilment of basic human needs are considered to be at the core of sustainable development, the focus on equity is limited by an assertion of the expectation of strict Pareto improvements ('improved living standards for all') through 'integration of environment and development concerns'. Further, since flows of 'new and additional financial resources' are aimed solely at covering 'incremental costs' that may be faced by DCs (Developing Countries) for actions to be taken by them, the equity content of the document does not encompass any principle of sharing global resources, internationally, or intergenerationally. While the Preamble does not mention the 'polluter pays' principle, which could be urged simply as a means of efficiency, without invoking equity considerations, later sections of the document speak of employing this principle in specific contexts.

Governments are identified as the key agencies for implementation, by way of 'national strategies, plans, policies and processes'. Implicit in this assignment is an acknowledgement that environmental protection and its harmonization with development cannot be left to unregulated private markets. At the same time, the reference to broadest public participation and active NGO involvement points to the need for the involvement of all in order to make Agenda 21 a success.

For ease of consideration, Chapters of Agenda 21 subsequent to the Preamble could be broadly classified into four parts, viz., Part-I addressing 'Social and Economic Dimensions' (Chapters 2–8), Part-II concerning 'Conservation and Management of Resources for Development' (Chapters 9–12), Part-III regarding 'Strenghtening the Role of Major Groups' (Chapters 23–32) and Part-IV on 'Means of Implementation' (Chapters 33–40). The rest of this paper is also structured along these lines.

Social and economic dimensions

Political aspects

This part of Agenda 21 focuses on those areas of the environment-development debate which are more directly linked with developmental issues, in particular their economic and social dimensions. The importance of a supportive international climate for achieving environment and development goals has been emphasized, and for this purpose sustainable development is to be promoted through trade liberalisation, making trade and the environment mutually supportive, providing adequate financial resources to DCs for dealing with their international debt, and encouraging appropriate macro-economic policies. An open, equitable, secure, non-discriminatory and predictable multilateral trading system in which the commodity exports of DCs can find markets at fair prices, and without the imposition of unjustified trade barriers, has been viewed as an importantly requisite for sustainable development.

The Chapter on poverty recognizes poverty as a complex, multidimensional problem, in whose solution country specific programmes would be crucial. It is accepted that the eradication of poverty and hunger, greater equity in income distribution, and the development of human resources are the major challenges around which all countries mustcooperate and share responsibility. It is particularly noteworthy that Agenda 21 acknowledges as a matter of grave concern that, while poverty results in certain kinds of environemental stress, the major cause of the continued deterioration of the global environment is an unsustainable pattern of consumption and production, particularly in ICs. Agenda 21 further recognizes the need to develop strategies to mitigate both the adverse impact on the environment of human activities as well as the adverse implications of environmental change on human populations. Expectedly, the protection and promotion of human health has been looked at as part of an overall strategy for achieving the WHO target of a minimum standard of 'health for all' by the year 2000.

The Chapter on promoting the development of sustainable human settlements is of particular importance since over one billion people around the world do not have access to safe and healthy shelter. However, the provision of adequate shelter and improvement of urban infrastructure and municipal services in DCs would require generation of considerable domestic resources over and above international cooperative efforts and aid flows. The identification of domestic finances to make the proposed action programme a success has correctly been left to each country. The reshaping of the planning process is another area where domestic changes in many countries may be required if Agenda 21 is to succeed. The main thrust of the Chapter on integrating environment and development is to urge nations and industrial enterprises to integrate at the outset environmental protection, degradation and restoration costs into decision making.

Economic implications

In contrast to the acknowledged need for government intervention for sustainable development in national policy contexts, trade liberalization is asserted to be generally conducive to environmental conservation, in addition to development goals. Further, the harmonization of national policies with a (supportive) international economic environment is asserted to be essential.

A strong result from economic theory is that under fairly tight assumptions, free trade is Pareto efficient, i.e., facilitates growth. One key assumption involved in this result is that in the presence of environmental externalities, property rights are created and costlessly enforced over environmental resources, in addition to conventional valued resources. In other words that a norm of 'internalization of all external effects' (a generalization of 'polluter pays') is embodied in a regulatory framework at the level appropriate to the externality impacts, i.e., local, national, regional, or global. Some multilateral regimes, e.g., the Montreal Protocol, the Biodiversity Convention, and a few others, attempt to do this. At the national level, the instances are more numerous, for example the U S Clean Air Act, etc.

Clearly, efficiency gains from trade would be increasingly realized as environmental regulation at appropriate levels becomes more comprehensive.

The document also implies that making 'trade and environment mutually supportive' is an independent condition for achieving environment and development goals. In fact, this condition is completely contained in the first, i.e., requiring the assignment of property rights in the environment. Of course, in the absence of fully liberalized trade with environmental property rights, there may exist scope for employing *trade restrictions* for environmental *protection*, although in this case there may not be any efficiency improvement over liberalization without environmental property rights.

DCs are concerned that environmental protection should not be a pretext for instituting non-tariff barriers on trade. One rider in the document is that account should be taken of the fact that 'environmental standards valid for DCs may have unwarranted social and economic costs in DCs'. Efficiency requires that standards must be related both to valuations of environmental damage by the impacted publics, as well as the costs of abatement. Two kinds of standards may be involved. Applied to processes, efficiency considerations would clearly debar trade restrictions premised on uniform, local or national environmental impacts. For processes whose environmental impacts are global, unilateral advances over global standards that may be adopted could be justified in terms of additional national objectives. However, if trade liberalization is an independent global objective, i.e., in addition to global environmental protection, a conflict may arise over these further national objectives, and the global imperative of trade liberalization. If efficiency is a strongly pressed global policy premise, the conflict must be resolved in favour of trade liberalization.

The possibility also exists that countries may attempt to subsidize environmentally benign technologies in export sectors. One issue that may arise is that other countries participating in multilateral trading regimes (GATT) may perceive such subsidies as intended to confer a competitive (financial) advantage to the sector, and thus violative of the multilateral regime. How exactly such a dispute would be resolved by the appropriate resolution mechanism is unclear. Another aspect is that a strong result from the economic theory of environmental regulation suggests that, under fairly general assumptions, such subsidies may, by encouraging entry into the (subsidized) polluting industry, increase the overall level of environmental damage.

Environmental impacts of products (i.e., after manufacture and sale) would relate to their impacts in use and disposal. If these are all contained within national jurisdictions, efficiency considerations may be used to justify unilateral, but uniform standards related to just these impacts, without regard to country of origin provided there are no other discriminatory (i.e., across countries of origin) barriers, either tariff

or non-tariff. This would retain the competitive advantage of the most efficient suppliers.

Accelerating the diffusion of (at least) process technology is a clear means of reducing environmental impacts. This could impact IPRs (Intellectual Property Rights) regimes in which trade-offs between static and dynamic efficiency are captured in the tension between weaker and stronger IPRs protection. Faster diffusion with strong incentive provisions for knowledge creation in IPRs regimes would imply a greater committment of financial resources to pay for such technology transfers.

Liberalization of foreign investment, debt relief, and general macroeconomic stabilization are urged in the document as significant for SD. The causal links between these and conventional GDP growth is well understood, but those with environmental protection require elaboration. Capital inflows and an outward orientation of national economies both facilitate and require greater technical efficiency in the use of natural resources, acknowledged by economists and policy makers to be an important attribute of SD. GDP growth itself, given appropriate policies, enables the adoption of environmental protection measures in national economies, since these may involve real resource costs. If such growth is also translated to the removal of poverty, people could alter unsustainable lifestyles, for example based on exploitation of common property resources, e.g., forests, grazing pasture land, and fisheries.

The subsection on poverty incorporates several paradigm shifts in the development literature that have occurred over the years, including by indirection that it has historical origins in national dominance, through acknowledgement of the 'shared responsibility of all countries' for the problem. At the same time, the assertion of poverty being a complex multidimensional problem may refer to its links with social structures, as well as culture, that have been discussed in the literature.

Approaches to poverty imply repudiation of subsidy based approaches to increasing consumption, or of significant intra- or international redistribution of resources. The focus is on (political) empowerment of the poor, including disadvantaged groups (women, indigenous communities), and human capital formation, primarily through education and professional training. In addition, emphasis on access to (not ownership of) productive resources, and income equity, involve a clear rejection of 'trickle down' growth. Indeed, a shift of emphasis from growth as the principal development criterion is manifest in requiring policies 'to simultaneously address development, sustainable resource management, and poverty eradication.' The currently believed strong causal linkages between poverty, women's status, population growth, women's access to health care, infant survival (breast feeding, clean water, and sanitation), are clearly embodied in the document.

Unsustainable patterns of production and consumption ICs (in International Countriess) are asserted in the document to be the major cause of global environmental degradation, aggravating poverty. Several themes have been articulated. These include redefinition of notions of growth to account for natural resource depletion, and of living standards which reflect SD concerns. Also, greater efficiency in production and altering consumption patterns, as well as of development in ICs, which have served as models of growth in many DCs. Policies to encourage these shifts include (largely) incentive based instruments to implicitly incorporate externality costs of resource use, dissemination of, increasing access to, and promoting R & D in environmentally friendly technologies, energy efficiency, use of new and renewable energy and natural resources, and assistance to DCs.

These recommendations, however, stop short of advocating major changes in ICs life styles, or advocating alternative growth paths in DCs. Incentive based instruments, which economists would tend to support unless market distortions were pervasive or administration costs were major, are not urged on efficiency considerations, but (apparently) in order that a decentralized decision process rather than fiats, accomplishes these objectives. A value judgement in favour of decentralization, also evident in the general emphasis in the document in empowerment of special groups and local communities, would be involved here. Efficiency considerations (broadly defined) are also implicit in amending concepts of GDP and redefining living standards.

Together with production and consumption, *world* population is asserted to stress the life-support systems of the earth, besides other critical resources. Once again a paradigm shift is evident. Earlier approaches to population increase, i.e., emphasis on technical means of reproductive choice, as well as material incentives for limiting family size have been eschewed. The document advocates, first, deeper research based understanding of population change and its links with technology, culture, natural resources, and life-support systems. Second, integration of population growth concerns in a wider environment and development perspective. For example, this would include urban management and local government issues in DCs.

This approach equates the issue of unsustainable production and consumption with that of population in terms of potential for environmental degradation of a life threatening kind. In addition, the avowedly holistic approach to population, would rule out any near term or 'big-bang' schemes for stabilization, and by implication, the world is committed to significant population increase in the medium term. The question of equitable entitlements to global resources given this committed increase, and the implications of such allocations for restraining present unsustainable production and consumption patterns, besides population growth itself, are not addressed.

Human health is viewed in the document as an instrument for 'sound development', rather than as an independent attribute of SD. Health risks are acknowledged to result from environmental impacts of development, and also from lack of development. A responsibility for governments in addressing health issues is evident. In fact, a stress on 'doing with' rather than 'doing for' could be interpreted as viewing health as a private good with some externality benefits, rather than as essentially a public good. This may have deep implications for designing systems of delivery of health care.

Proposals for promoting sustainable human settlements envisage a comprehensive approach to shelter, urban management, infrastructure, equity in land use, transportation, safety, and the construction industry. Clearly, but implicitly, much initiative would vest with national and local governments. What is missing? The urban settlements sector is extremely capital and skills intensive. The question of skills is addressed, that of resources is implicitly left to national governments. The latter aspect also involves the question of institutional structures within countries to tap domestic resources and operate infrastructure and utilities, besides mass transportation, efficiently. The question of such institution building in the urban settlements sector is a clearly a major challenge for sustainable development.

The principal field for capacity building remains policy making. Most DCs are short of the critical human resources of entrepreneurial, managerial, and administrative capacity. Further, generations of policy makers in DCs have acquired the reflex of

making policies by sector i.e., piecemeal, employing instruments which attempt detailed case by case regulation by fiat, and which are accordingly intensive in the use of bureaucratic resources and information. Agenda 21 proposals regarding policy making for SD envisage a sharp reversal of these practices. In particular, the integration of planning in all relevant areas of environment and development is envisaged. Further, while the use of decentralized regulatory instruments, in particular those which work through market signals, as well as the removal of distortionary incentives, is recommended, there is also emphasis on a broader range of public participation. This latter aspect may be owing to the fact that in several areas of economic activity, market failures may occur on the demand side, including for example, environmental quality, and social and physical infrastructure, and accordingly, unregulated market approaches may be inefficient.

Conservation and management of resources for development

Political aspects

Noteworthy in the Chapter on protection of the atmosphere is the importance attached to reducing uncertainities in areas such as climate change and climate variability, air pollution and ozone depletion. The intention behind this focus is to improve the scientific basis for decision making. It is equally interesting that the chapter on protecting the atmosphere does not mention fossil fuels, covers all greenhouse gases, and limits commitments for corrective action to the agreements reached in the Framework Convention on Climate Change (1992). It is also of considerable significance that Agenda 21 identifies the importance of the growing reliance that would have to be placed on environmentally sound energy systems, particularly new and renewable sources of energy. The debate over whether environmentally 'safe and sound' energy systems should be considered for promoting sustainable development or whether environmentally 'sound' energy systems would suffice was a major contentious issue which only got resolved on the final day of UNCED. While a consensus was ultimately reached, a couple of delegations from oil producing States, insisted on placing on record their objections to what they described as the promotion of the utilization of 'unsafe and environmentally unsound technology and energy sources, such as nuclear energy'.

Agenda 21 also visualizes an integrated approach to land resource use which would involve simultaneous consideration being given to environmental, social and economic issues. Similarly, the chapter on the 'Conservation and Rational Use of Forests' emphasizes the importance of recognizing the social, economic and ecological values of forests and the need to incorporate such values into national accounting systems. The contents of this chapter are further buttressed by the adoption separately of a 'Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests'.

The problems posed by desertification and drought for a very large number of DCs has been focussed upon in a separate chapter. Priority has been accorded to halting the spread of deserts by adopting preventive measures, particularly for lands which are not yet degraded, or which are only slightly degraded. At UNCED agreement was, however, reached to elaborate an international convention to combat desertification in

those countries experiencing serious drought and/or desertification, particularly in Africa, and such a convention is to be finalised by June 1994.

Like the Convention on Biological Diversity (1992), the Agenda 21 chapter devoted to biodiversity recognises the sovereignty of States over their genetic resources, and its contents essentially parallel the matching provisions of the Biodiversity Convention. The chapter on environmentally sound management of biotechnology calls for the transfer of biotechnology to DCs and the creation of the the necessary infrastructure as regards capacity building and human resource development in DCs.

The chapter on the protection of the oceans recognises that the rights and obligations of States set out in the UNCLOS (the UN Convention on the Law of the Sea) provides the international basis on which to pursue the protection and sustainable development of the marine and coastal environment and its resources. It is specifically recognised that the implementation by the DCs of the activities listed in the chapter would be commensurate with their individual technological and financial capacities and priorities in allocating resources for development needs, and would ultimately depend on the technology transfer and financial resources required and made available to them. An intergovernmental conference would be convened under UN auspices with a view to promoting the effective implementation of the provisions of UNCLOS on straddling fish stocks and highly migratory fish stocks. However, the work and the results of that conference would have to be fully consistent with the provisions of UNCLOS, in particular, those relating to the rights and obligations of coastal states and states fishing on the high seas. The chapter on protection of the quality and supply of freshwater resources is of particular interest to DCs. As regards drinking water supply and sanitation, it bases proposed activities on the four guiding principles of the New Delhi Statement of 14 September 1990, which formulized the need to provide, on a sustainable basis, access to safe drinking water in sufficient quantities and proper sanitation for all, emphasising the 'some for all rather than more for some' approach. Freshwater management is proposed to be holistic, and based on a balanced consideration of the needs of people and the environment.

The chapter on environmentally sound management of toxic chemicals includes a separate programme area on prevention of illegal international traffic in toxic and dangerous products and incorporates noteworthy references to the prior informed concent procedure. It is noteworthy that the chapter on environmentally sound management of hazardous wastes includes as an overall target the requirement of ensuring that environmentally sound hazardous waste management options be pursued to the maximum extent possible within the country of origin ('self-sufficiency principle'). Governments are also required to ascertain that their military establishments conform to their nationally applicable environmental norms in the treatment and dsiposal of hazardous wastes. Of particular interest in the chapter on safe and environmentally sound management of radioactive wastes is the requirement that states not promote or allow the storage or disposal of high level, intermediate level, and low level radioactive wastes near the marine environment unless scientific evidence, consistent with the applicable internationally agreed principles and guidelines, shows that such storage or disposal poses no unacceptable risk to people and the marine environment or does not interfere with other legitimate use of the sea.

Economic aspects

The impacts of anthropogenic activities on key resources: atmosphere, forests, land, oceans, freshwater, etc., are profoundly uncertain. A major thrust of proposals for resource management, accordingly, centre on reducing uncertainties through research.

A second focus of proposals on resource management is the development of capacities and capabilities for research on impacts, planning and policy making, and technological innovation and absorption.

A third area of emphasis is the empowerment of groups which would be adversely affected by degradation. The underlying belief is that public policies have major impacts on conservation of natural resources, and that by such empowerment, policy making could be influenced in the direction of sustainability. Since many of these potentially impacted groups, for example indigenous people, might also be identified as underprivileged, there is an apparent synergy between equity and sustainability concerns.

One major resource which is adversely impacted by economic activities is the atmosphere. This is because of its close links with energy supply and use. The atmosphere is the principal recipient of environmentally damaging discharges from the use of fossil fuels. The impacts may be at all levels: local, regional, global. In particular, the costs of global impacts, largely on climate, may be very high, but are uncertain over wide limits. Uncertainties are involved both in mapping the build-up of pollutants from specific energy use activities, as well as how they translate to adverse climatic and other externality impacts. Accordingly, the proposals on protection of the atmosphere focus on the production and use of energy.

Energy production and use is, of course, intricately linked to economic activity, and is a principal determinant of living standards and development. The tension between development and environmental protection, sought to be resolved in concepts of SD, is nowhere sharper than in the energy sectors.

Energy is a ubiquitous input in production, and in the long-run, a substitute for (or may be complemented by) other inputs: Land, labour, capital. It is also an important good in both private and public consumption, besides constituting a major revenue source through indirect taxes, royalties, and leases. Policies that impact energy supply and use, can thus, through inter-industry linkages, and changes in factors use, impact all sectors, besides incomes, savings, investment, and public and private consumption. Changes in international comparative and competitive advantage could also clearly occur, affecting patterns of trade. Any scheme for environmental protection focussing on the energy sectors will, therefore, have to address the potential wideranging impacts on the economy.

Agenda 21 proposals attempt a fairly comprehensive approach, recommending national planning to integrate energy, environment, and economic policy in a sustainable framework. The internalization of environmental costs through economic (incentive based) and regulatory (fiats) measures is also urged as a planning goal. Economists generally prefer incentive based instruments which, in effect, price the resource to the user, to fiats. The former, under a set of assumptions, will permit a given level of environmental quality to be reached at the least resource cost. Several incentive based instruments., e.g., pollution taxes, tradeable permits, may also be designed to raise significant revenues for funding SD measures, or meeting equity concerns. However, Agenda 21 does not urge the adoption of (economic) regulatory instruments in a multilateral framework, i.e., with States as the regulated agents.

One important set of policies which may have significant complementarities with economic efficiency goals is increased energy efficiency and conservation. The reduced use of primary energy, in particular fossil fuels, through increased energy efficiency will reduce polluting emissions and discharges, and thus promote sustainability. Accordingly, the document also proposes the development and use of energy efficient technologies, setting goals for energy efficiency, and technology transfers to DCs. Of course, under the Climate Convention, the responsibilities of DCs for implementing national abatement strategies is conditional not only on the fact of such technology transfers, but also on the '(agreed) full incremental costs' ('agreed': under norms to be decided) being met by ICs. Questions relating to the appropriate depth of technology transfer would need to be addressed in future negotiations. Several energy sources are identified as 'sustainable' and therefore as meriting increased research. These include solar, wind, geothermal, hydropower, and biomass (including wood). All of these, of course, have a range of environmental impacts. On the other hand, nuclear power may, on balance, have lower environmental costs than these named sustainable energy sources. The listing of 'sustainable' energy sources thus, does not appear to have been examined on the basis of economic (efficiency, equity, sustainability) criteria.

Land resources are also subject to stress from a diversity of economic activities. The objectives of land resource conservation measures are articulated as the allocation of land efficiently, i.e., maximization of sustainable net benefits, with the empowerment of potentially impacted groups a matter of additional emphasis. A focus on private property also reflects economists' belief that the common property nature of many land resources fosters their unsustainable use, leading to degradation. A review of the regulatory framework, including legislation, is urged for promoting sustainable land management, but also to restrict the transfer of arable land to other uses. This may conflict with efficiency, and represents an *a-priori* political determination that the diversion of agricultural land to other uses is not desirable from the viewpoint.

Proposals for forestry conservation recognize the use of this resource in multiple economic uses, besides ecological, social and cultural uses. This reflects the belief that deforestation arises largely from the failure of existing institutions to internalize the value of externality benefits which are in the nature of non-excludable public goods, leading agents to neglect societal costs of deforestation. However there are major difficulties in designing policy instruments to accomplish such internalization by decentralized agents, and the principal means of arresting deforestation remain direct government regulation, and recognizing and enhancing the rights of traditional users of forest resources. There are large uncertainties in computing the value of external benefits of forests, and accordingly, their incorporation in national accounting systems may also present serious difficulties.

Some approaches to conservation in the document include promoting non-wood forest products, eco-tourism, and more efficient fuelwood harvesting and use. These may enhance the private benefits from forestry, and accordingly reduce deforestation rates.

Capacity building in the forest sector is a major focus of the proposals. This follows from recognition of the multi-disciplinary nature of forestry management, which is the key to effective Government regulation of the resource.

The priority in combating desertification is preventive measures on lands not yet (or only partly) degraded. This may reflect an assumption that the net benefits of

investments in prevention are likely to be greater than in the case of reclamation. The possibility of serious contributions from indigenous knowledge to scientific research in these aspects is recognized. However, some traditional livelihoods may have become unsustainable due to drought and population increase, and these may be altered. The fact that cultural transitions may be involved is, however, not addressed. This accords with the omission of human culture as among the attributes of sustainable development.

Droughts may lead to disaster and refugee problems. While relief measures are proposed, the question of drought (disaster) arising as a result of external activities, meriting compensatory rather than paternalistic responses by the concerned entities, is not discussed.

Mountain ecosystems are a valuable component of global ecosystems. Approaches to conservation of the resource focus, first, on the fact that it is still inadequately researched, and second, on the development of alternative activities at the village level which could be undertaken in sustainable ways.

Approaches to agriculture focus on removing policy distortions in many countries, as well as trade barriers. This may enable DCs in general to realize their competitive advantage in many agricultural commodities. There is, however, no specific mention of price stabilization. A framework for food security is recommended, including the transfer of storage and distribution technologies. Other interesting proposals relate to ensuring access to agricultural resources to underprivileged groups, extending financial networks (which may require increased research and experimentation in credit delivery methods to underprivileged groups), sharing benefits of R & D in plant breeding and seed production, integrated pest management, and soil fertility management. In particular, an energy transition in rural areas is necessary: this may increase reliance on fossil fuels.

Conservation of biodiversity is, of course, a principal aim of the entire movement for sustainable development. Proposals for biodiversity generally reflect the principles involved in the Biodiversity Convention, but do not elucidate the contractive framework facilitating access to national genetic resources in return for (resultant) biotechnology transfer. The use of EIAs (Environmental Impacts Assessments) for evaluating projects likely to impact biodiversity is advised: The technique is, however, still difficult to translate to actual cost-benefit analyses, an evaluation methodology with which policy makers and international agencies are generally familiar, because of problems of information. Further, while the use of economic incentives for conservation and sustainable use is recommended, whether the opportunity costs of conservation, i.e., the net economic benefits lost from not employing the resource to the best alternative use, should be forthcoming from multilateral sources, is not addressed. In fairness, this should be the subject of future protocols under the biodiversity Convention.

The document points to the emerging promise of biotechnology in numerous applications, and to the potential for cooperation between ICs and DCs, in indirect reference to the contractive framework in the Biodiversity Convention. The document is also a little stronger than the Biodiversity Convention on the issue of entitlements to commercial and economic benefits from biotechnology for indigenous peoples.

Proposals for ocean resources focus on sedimentation, pollution, injurious fishing practices, and climate change. Land based activities are asserted to adversely impact the ocean's biological resources. The creation of Exclusive Economic Zones (EEZ) are asserted to be conducive to natural resources conservation. This generally accords with economic logic.

Another significant dimension of conserving ocean resources relate to climate change impacts. The emphasis is on global exchange of research based information, in particular of small island states, which are particularly threatened. Such states are to be assisted for adaptation by ICs, but the document is silent on the question of liability for damage, an issue touched upon in the Climate Change Convention.

Freshwater resources are another important subject of Agenda 21. It is recommended that discharge standards may be set as well as 'polluter pays' invoked. As pointed out above, there is, however, an essential dichotomy between standards and incentive based instruments (including liability regimes) embodying polluter pays. The former do not, in general, ensure cost minimization for a given environmental standard, while the latter do so under some assumptions. The proposals also include research on the impact of climate change on freshwater supplies, and for contingency planning.

The safe use of toxic chemicals is another focus of Agenda 21. The proposals include improved risk assessment, as well as the right of communities and individuals to information. It is recommended that governments should employ the principle of producer liability. The rationale for this principle derives from the likely assymetry of information on risks between producers and users, including intermediate handlers.

The management of hazardous waste is another theme of Agenda 21. Policy approaches recommended in the document focus on international cost-benefit guidelines for hazardous waste production and management. By implication, the major evaluative principle is economic efficiency. The question of equity would then presumably be dealt with by national authorities, involving an assumption that impacts would be limited to national jurisdictions. The ethically sensitive issue of international trade in hazardous waste is adverted to in several ways. While no outright ban is proposed, a ban may apply when recipient countries lack the capacity to handle them in environmentally sound ways. Further, recipients are urged to treat wastes in a manner consistent with regulations in the country of origin: Presumably this will ensure a measure of reduction of impacts. Illegal trade will require penalties, legislation, monitoring, and enforcement.

Agenda 21 proposals for solid waste involve programs to minimize waste creation, reuse, and recycling, principally by incentive based instruments, international standards for environmentally sound treatment and disposal, and extending waste handling services through national planning and international cooperation. The efficient level of reuse/recycling will vary across countries, depending on their resource endowments. In general, labour rich DCs may be enabled by properly designed incentive based policy instruments, to accomplish higher levels of reuse/recycling than labour scarce ICs.

Radioactive wastes are also considered in Agenda 21. One proposal is to enhance transfer of technology for storage, transport and disposal to DCs. This is interesting because one barrier to increased investment in nuclear power generation by DCs is lack of such waste handling technology.

Strengthening the role of major groups

Political aspects

The Preamble to this chapter recognizes that the commitment and involvement of all social groups would be critical to the effective implementation of the objectives, policies, and mechanisms agreed to under Agenda 21. Separate chapters address the

crucial role of women, youth, indigenous people, NGOs, local authorities, workers and trade unions, business and industry, science and technology and farmers in this regard. The chapter on women urges governments to address directly the question of the status of women, provide girls equal access to education, reduce the workload of women, and take a variety of measures so as to secure the full participation of women in all aspects of cultural, social and public life. As regards youth, a target has been set by which governments are urged to ensure that by the year 2000, 50% of their youth are enrolled in or have access to secondary or equivalent education or vocational training programmes. The chapter on indigenous people recognises that the developed world has much to learn from indigenous people as regards sustainable development methods, and urges their involvement in the global partnership.

Economic aspects

An important dimension of sustainable development concerns is the status, entitlements, and say in family and societal decision-making, of women. It is now conventional wisdom that development programs frequently, often through neglect or oversight at the stage of formulation and/or implementation, impact women. These impacts are typically adverse, because planners and analysts are usually not sensitized to women's issues. Accordingly, the emerging sustainable development paradigm makes it imperative to conduct Gender Impact Analyses of project and programs, so that the women's dimension in development is fully taken account of in the policy-making process. Environmental degradation in DCs is now believed to usually have significant differential and unfavourable impacts on women. Entitlements to food may be reduced, and because of the increasing difficulty of collecting fuel, drawing water, and grazing livestock, there is increase in drudgery. Time spent on infant and child care is also reduced, adversely affecting the health and prospects for the literacy of the next generation. Environmental degradation may also increase the demand for child labour time in household chores and petty tasks of livelihood, reducing further the chances of school enrollment and retention.

Proposals in Agenda 21 on actions for women's status and welfare recognize that their education and empowerment, in the family, in society generally, and politically, can have deep impacts on population growth, schooling, infant mortality, sanitation, nutrition, and resource conservation. The proposals accordingly focus on these two objectives, i.e., women's education and empowerment.

Specific proposals include, first, formulating a strategy for eliminating constitutional, legal, administrative, cultural, behavioral, social and economic obstacles to women's participation in sustainable development and public life. Second, priority measures are recommended for disseminating gender-relevant knowledge and promoting the enhanced value of women's roles in educational curriculum. Third, measures to eliminate female illiteracy, assure universal access to girls' primary and secondary education, as well as increase their opportunities for technical and professional training. Fourth, enhancement of women centered and managed health care, including reproductive services, and making them more accessible. Additionally, equal employment opportunities and equal pay for women should be supported by day-care and parental leave. There are several further recommendations.

Other groups, identified as 'social partners for sustainable development' include youth, indigenous peoples. NGOs, local authorities, workers and trade unions, business and industry, the scientific and technological community, and farmers. Proposals seek

to identify their interests, and possible roles in sustainable development. In particular, it is recommended that youth be involved in decision making relating to their future. The long-standing relationship of indigenous peoples with their lands, and their holistic scientific knowledge of natural resources and the environment is recognized. Further, it is recommended that their participation in national and international sustainable development decision making should be enhanced.

Means of implementation

Political aspects

Financing of implementation of Agenda 21 was a major issue of contention before UNCED. While, in general, such financing is to come from a country's own public and private sectors, UNCED recognized that for DCs substantial new and additonal funding for sustainable development and implementation of Agenda 21 will be required. Moreover, developed countries reaffirmed their commitment to reach the accepted UN target of 0.7% of GNP for ODA and to augment their aid programmes in order to reach the target as soon as possible. Some developed countries agreed to reach the target by the year 2000. The Commission on Sustainable Development would regularly review and monitor progress towards this target and review process would systematically combine monitoring of the implementation of Agenda 21 with a review of the financial resources available. Funding for Agenda 21 and other outcomes of UNCED is to be provided in a way which maximises availability of new and additional resources and which uses all available funding resources and mechanisms. The summit called for 'special consideration' to be given at the forthcoming meeting of IDA Deputies to the statement made by the President of the World Bank in the UNCED Plenary, in which he had made a compelling case for providing IDA with additional funds to help the poorest countries meet their environmental objectives. Developed countries and others in a position to do so are to make initial financial commitments to give effect to UNCED decisions, and are expected to report on such plans and commitments to the 47th UNGA. In turn, DCs are expected to begin drawing up national plans for sustainable development to give effect to UNCED decisions. While UNCED was never meant to be a pledging Conference, it is noteworthy that some developed countries indicated at it specific financial commitments for enhancing the capacity of DCs to tackle environmental and linked developmental issues. Japan, for example, will increase aid for sustainable development to $7–7.7 billion over the next five years. The EC pledged $4 billion and Germany agreed to meet the ODA target of 0.7% of GNP for development aid. The UNDP, GEF and others are also expected to provide increasing funding for environment projects. The cost of implementing Agenda 21 has been estimated at US$600 billion per annum, including US $125 billion in technical and economic assistance to be provided by the developed countries. It is, however, pointed out that these cost estimates are indicative in nature, have been prepared by UNCED Secretariat, and were not reviewed by governments.

Agenda 21 also addresses both the issues of improved access to and transfer of environmentally sound technologies and corresponding know-how to DCs on favourable terms (including on concessional and preferential terms as mutually agreed) and the strengthening of institutional capacity in DCs.

A key element amongst the decisions taken at UNCED—with a view to the implementation of Agenda 21—was a recommendation to the 47th UNGA to establish a

high-level Commission on Sustainable Development (CSD). The 47th UNGA would determine the specific organisational modalities of the work of the CSD, including the question of its composition and membership, relationship with other UN bodies, frequency, duration and venue of its meetings, etc. The CSD would report to the UNGA through ECOSOC. It would have a crucial role to play to maintain the momentum created at UNCED so as to ensure that decisions reached at UNCED are effectively carried out.

Economic aspects

The question of technology transfer is at the core of practical measures for sustainable development. Technology transfer is defined to include knowledge, goods, services, and organizational procedures. Support to DCs is asserted to be necessary to build up their economic, technical, and managerial capabilities.

The issue of IPRs protection is the central issue in transfer of environmentally benign technologies. While it is asserted that much relevant technological knowledge is not covered by IPRs (i.e., is in the public domain), the role of international business in transfer of proprietory technology is emphasised. The question of access to state-of-art technologies by DCs through facilitation and financing is emphasised, together with providing fair incentives to innovators.

The traditional policy concern in design of IPRs regimes is to trade-off diffusion possibilities (disclosure of knowledge to the public), which enhance static efficiency, with incentives for innovation (i.e., property rights over created knowledge), which may motivate innovation, in order to realize dynamic efficiency. The introduction of environmental protection concerns does not fundamentally alter the nature of this tradeoff: the benefits of enhanced environmental quality (as well as the costs, including the resource costs of R & D for environmentally benign technologies) may be valued, and inserted into the (dynamic) cost-benefit calculus. However, since DCs may value environmental quality differently from ICs, and their choice of social discount rate may (quite legitimately) also differ, a case is apparent on simple efficiency grounds, without invoking any equity considerations, for differential levels of IPRs protection in DCs and ICs. If (future) environmental benefits are valued lower in DCs as compared to ICs, and their social discount rates are also higher, both reasonable assumptions, the (dynamic) efficient levels of IPRs protection in DCs should be lower, since it is current diffusion rather than future innovation that would yield the greater relative benefits in their case. Such lower levels of IPRs protection would, however, result in reduced IPRs rents to ICs innovators.

'Capacity Building' in terms of Agenda 21 proposals is the *prima-donna* of international cooperation for sustainable development. Capacity building comprises developing a country's human, scientific, technological, organizational, institutional, and resource capabilities. Each country is urged to complete, by 1994, a review of its capacity building needs. Programs should improve countries' ability to respond to long-term, rather than only immediate problems. Capacity building also, clearly, involves technology transfer.

Sustainable development involves major reorientation of the process and objectives of growth. It has assimilated the lessons of the development experience over the last four decades, and seeks to integrate poverty removal, resource conservation, different categories of equity concerns, empowerment of women and other disadvantaged groups, financial and technology transfers, research and development,

besides economic growth, in a holistic framework. The entire approach is multidisciplinary, local as well as regional and global in scope, and relies on a range of institutions: governments, markets, NGOs, and others. The question of enhancing the human capital resources of countries, their knowledge base, and institutional capabilities is obviously crucial to this effort.

Cooperation in capacity building is not a straightforward North-South affair. DCs too possess significant resources of human capital and know-how, and South-South, as well as regional cooperation, are alternative approaches. These may also be more cost-effective than a preoccupation with North-South capacity transfers.

Conclusion

Agenda 21 represents a serious attempt at harmonizing current understanding of the development process and environmental protection, with political perceptions and priorities. These could change over time, and accordingly Agenda 21 is designed as a dynamic document.

Apart from questions of provision of new and additional financial resources and technology transfer, a crucial element in effective implementation, is national capacity building. The building up of technical skills, administrative capacity, policymaking sikIls, and institutional design is a major focus of the proposals, in which there exists considerable scope for multilateral cooperation involving all sectors and players.

The Framework Convention on Climate Change

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Covering as it does vital questions of energy production, consumption, as well as forestry and land use patterns the Framework Convention involved one of the most significant environmental as well as economic negotiations undertaken in recent years. The negotiations were driven by a political decision to conclude an agreement in time for the Rio Summit. It was remarkable that a Convention of such complexity and importance was indeed concluded in little over a year, to be precise 15 months. The logical framework of the exercise is reflected quite clearly in the Convention. However, given the time factor, it should come as no surprise that in some respects, the negotiations were not truly completed and a number of important questions were left for subsequent resolution after the Convention comes into effect.

The object of my talk is two fold.

1. To indicate an outline of the logical framework or rationale of the Convention.
2. To spell out the questions which remain to be addressed.

The most important feature of the Convention is that it provides a framework for a logical set of actions by the international community to deal with Climate Change problem. The basic features of the Convention can be summarized as follows:

1. The general commitments (Article 4.1) are based on 'Common but differentiated responsibilities'. The Convention recognizes in its Preamble 'that the largest share of historical and current emissions of GHGs has originated in developed countries, that per capita emissions in developing countries are still relatively low, and the share of the global emissions originating in developing countries will grow to meet their social and development needs'. The Convention therefore logically concludes that, 'the extent to which developing country parties will effectively implement their commitments under the Convention will depend on the effective implementation of developed country parties of their commitments under the Convention related to financial resources and transfer of technology, and will take full into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country parties'. (Article 2.7).

   More specifically the Convention provides, the developing country parties shall be provided the 'agreed full incremental costs' of implementing measures under the Convention. The Convention thus clearly establishes that the obligation of developing countries are restricted to measures which are compensated by payment of agreed full incremental costs (Article 2.3). In the case of certain other obligations (under Article 12.1), the 'full incremental costs' are to be provided.
2. In the case of developed country parties and countries with economies in transition, that is industrialized East European countries, certain specific commitments of standardization and reduction are laid down in Article 4.2. However, a number of specific details need to be worked out in the first meeting of the conference of parties. This specific obligations of the developed countries

and industrialized East European countries flow logically from the responsibility for inducing the phenomenon of climate change.

3. The developed countries, but not East European states are additionally required to provide the new and additional financial resources required by developing countries. The exemption of East European states from financial obligation can be justified on the basis of differences in 'respective capability between them and other developed countries'.
4. In keeping with the principles of differentiated responsibilities Article 12 requires developing countries to provide general information on steps taken and envisaged by them to implement the Convention, and any other information which they consider relevant in this connection, including, the feasible material relevant for calculation global emissions trends. The developed country parties as well as the East European countries are additionally required to provide detailed descriptions of policies and measures adopted to implement their specific commitments (under Article 4.2) and the effects of these policies and measures on GHGs emission by sources and absorption by sinks. Developed countries but not countries with economies in transition are also required to furnish details of measures taken by them to provide new and additional financial resources to developing countries, assistance to developing countries to meet the cost of adaptation, measures taken to promote, facilitate, and finance transfer of environmentally sound technologies.

I now come to the questions which the Conventions itself recognizes as requiring further consideration. It is not my intention to give an exhaustive account of the tasks which are to be taken up in the first session of the Conference of Parties. My intention is only to focus on certain specific tasks, which the Convention itself recognizes as unfinished.

These relate to Article 4.2 concerning the specific commitments of developed country parties and industrialized East European countries.

The Convention provides the following:

1. Article 4.2(a) requires developed country parties and so called economies in transition to adopt national policies to limit and reduce GHGs emissions and protect and enhance their respective GHGs sinks, recognizing that the return by the end of the present decade to earlier levels of emissions would contribute to modified long term trends consistent with the objective of the Convention. It allows such countries to implement such policies and measures jointly with other parties. However, the concept of joint implementation, has not been spelt out. It could be interpreted as joint implementation between developed and developing countries. This would be consistent with a tradeable rights approach. But on the other, efforts may also be made to interpret it as joint implementation between developed and other industrialized countries, thereby shifting international cooperation from a North-South to an East-West axis. Since emissions in East Europe have generally shown a declining trend since 1990 on account of temporary contraction of economic activity, so called joint implementation may project a picture which is deceptive in the long run. The concept therefore requires clearer definition. Article 2.4 sub para (d) therefore specifically requires that the Conference of Parties at its first session take decisions regarding criteria for joint implementation.

2. Article 4.2(d) requires developed countries and the East European economies in transition to periodically provide details of policies and measures, as well as the resulting impact on projected emissions from sources and removal by sinks of GHGs, with the aim of 'returning individually or jointly to their 1990 levels'.

Methodology of calculations of emissions and removal of GHGs remains to be worked out. Article 4.2(c) therefore specifically requires that this be considered and agreed upon in the first session of the Conference of the Parties. Finally, and most importantly, the Convention specifically requires under Article 4.2(d), a review of the adequacy of commitments undertaken by the developed and other industrialized countires. In Article 4.2(a) the Convention provides that these countries should 'return by the end of the present decade to earlier level', of anthropogenic GHG emissions. In this connection with the time frame however no specific earlier level is identified. In a different sub-para 2(b) there is a specific mention of 1990 levels, but in this there is no reference to the time limit. There is an obvious need to remove this ambiguity, together with the ambiguity which still remains in the joint implementation proposals. Moreover the question of further reduction of emissions of developed countries and economies in transition beyond 1990 levels requires to be addressed. For all these reasons it is extremely important that a through review be undertaken of sub-para 2(a) and (b) of Article 4. The need for such a review in the first session itself of the Conference of Parties is recognized and provided for in sub-para 2(b). The sub-para furthermore provides that 'based on the review the Conference of Parties shall take appropriate action which may include the adoption of amendments to the commitments of sub-paras (a) and (b)'.

To sum up, the Climate Change Convention itself indicates area when further negotiations are required. These pertain to the core area of the Convention, namely, the specific commitments of developed and other industrialized countries which are responsible for the Climate Change phenomenon. Unless satisfactory solutions are found to these unresolved questions, the Convention will fall short of being an effective instrument of combatting Climate Change.

The Framework Convention on Climate Change: some underlying economic issues

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'.....one unifying characteristic of environmental resources is their regenerative capacity, a capacity which can be destroyed if they are exploited unwittingly.'
(P. Dasgupta)

After two years of intense debate and negotiation, a number of countries have signed the United Nations Framework Convention on Climate Change at Rio de Janeiro in June, 1992. The Convention aims at stabilising the concentrations of all GHGs (Greenhouse Gases) so as to reduce a major threat to sustainable development i.e., dangerous anthropogenic interference with the Earth's climate system.

Several important economic issues relating to the global environment have come to fore in the Convention. This paper attempts to highlight and examine some of these issues from a developing country perspective. First, we look at the economic rationale for this Convention. This is followed by an analysis of technology transfer, macro-economic implications and international trade in the light of the Convention. The concluding section discusses some implications for future protocols to the Convention.

Externalities, free rides and market failure

Consider a firm that faces a perfectly elastic demand curve for its output.[1] Also assume rising MPC (Marginal Private Costs).[2] This implies that the total cost of producing an additional unit of output increases more than proportionately with every unit produced, as illustrated in figure 1.

At equilibrium, the firm maximises profits by producing output O_B at which its marginal cost of production equals the price. This, however, is a narrow treatment of costs. Suppose CO_2 is emitted during the production process as a by-product. Then, in addition to the private costs, the external costs of these emissions (in an extreme case, climate change) also need to be included in determining the MSC which is the true cost to society. In other words,

Marginal Social Cost = Marginal Private Cost + Marginal External Cost.

The MSC (Marginal Social Cost) to produce a given level of output will always exceed the corresponding MPC as long as the marginal external cost of production at that level of output is greater than zero. Hence, the optimum (maximum net benefit) level of output for society is less than that produced by the plant. In this case it is O_A where the MSC equals price. Consequently, the plant produces an excess output of

$(O_B - O_A)$.

[1] A perfectly elastic demand curve implies that the plant faces infinite demand at the given market price. In other words, the plant is too small to influence this price and can sell any amount of its output.

[2] Private costs comprise the costs of land, labour, capital, materials etc.

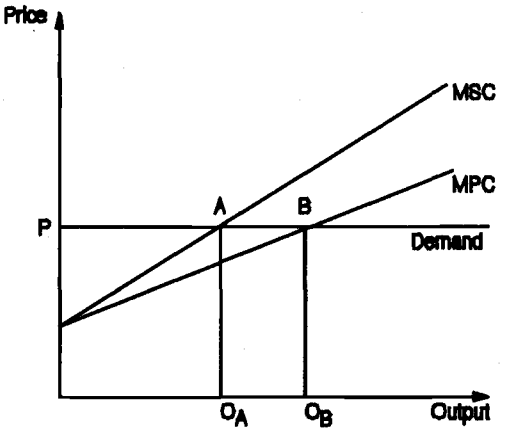

Figure 1

Another familiar example is that of deforestation in Brazil. The private cost of deforestation—atleast as far as the problem of GHG emissions is concerned, is less than the associated global cost. Hence, while a policy of deforestation may make 'economic' sense for Brazil, it is inefficient from the point of view of the rest of the world.

The phenomenon of MSC exceeding MPC is characteristic of exploitation of 'common resources', including the Earth's atmosphere. No country bears the full brunt of its polluting activities or enjoys the full benefits of environmentally friendly measures. Hence, there is a tendency to 'free ride'. This tendency is exacerbated by the non-excludable nature of the atmosphere. Thus, in the presence of externalities and non-excludability, the market mechanism fails to ensure an optimum allocation of resources. The crux of the problem is that agents (firms, countries, etc.) do not face the social costs of their actions. Free riding is their strategic response which leads to market failure. It is here that governments have a role. Through environmental policies governments can ensure that polluters bear the cost they would shift onto the consumers. Likewise, without a world government, no existing institution can compel international polluters to pay [The Economist, May 30, 1992]. In a situation where unilateral action would be grossly inadequate, an international agreement is, ideally speaking, a (peaceful) way to make countries participate in containing anthropogenic climate change, without having some countries free ride on the efforts of others. The recognition of the need (and advantages) of global action to contain the present rate of GHG emissions was the starting point for the Rio Convention.

Technology transfer

OECD estimates suggest that by the middle of the next century, stabilisation of CO_2 emissions by its member countries at current levels would reduce world output of CO_2 by 11% from the level it would otherwise have reached. This reduction could, however, be largely negated if the developing countries, in their pursuit of development, spew

more GHGs into the atmosphere. On some estimates, the CO_2 output of China would alone exceed that of the entire OECD.[3]

In recent years there has been a movement towards the development of environmentally friendly technologies (especially in Japan and Germany). These are technologies that use the earth's resources and its capacity to absorb waste as frugally as possible [The Economist, May 30, 1992]. However, due to the lack of purchasing power of the developing countries, institutional and other constraints, the access of these technologies to the developing countries has been limited. This limited access to benign technology can hinder global efforts to stabilize anthropogenic emissions of GHG.

This is where the role of policy measures to facilitate technology transfer comes in. Technology transfer is defined as the process by which technology, knowledge and/or information developed in an organization, in a given area, or for a particular purpose, is applied and utilised in a different setting or context.[4] It may take the form of a license for the use and revelation of a given technology for a specified term in exchange for royalty, and subject to other conditions (e.g. restrictions on further transfer, R & D (Research and Development), exports, etc).

If developing countries have access to environmentally sound technologies early in their development process, the potential damage to the environment as a by-product of development can be mitigated. Recognising this point the Convention makes the following provision:

> 'The developed country Parties ..... shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of environmentally sound technologies and know—how to other parties, particularly developing country parties, to enable them to implement the provisions of the convention.' [Article 4(5)]

We analyse technology transfer in three categories

A. Getting developed countries to share their technical know-how

Technology can be crucial in gaining international competitiveness. Also, strong IPR regimes, (as portended by the draft Dunkel text[5]) yield significant economic rents to their holders, mainly agents in developed countries, which may be captured through exports of goods embodying the technology, no less than through royalty payments involved in the transfer of the technology in question. It may not, therefore, be in their interest to transfer state-of-the-art technology to others.[6] Instead, the temptation would be to transfer previous generation technology, which could, of course, be superior to

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[3]The Economist, May 30, 1992.

[4]Bell, Martin—*Continuing Industrialisation, Climate Change And International Technology Transfer*, Science Policy Research Unit, University of Sussex, December, 1990.

[5]The draft Dunkel text is the draft presented at the Uruguay Round of the GATT negotiations by the Secretary General, Arthur Dunkel.

[6]In fact, 99% of the 3.5 million patents are taken in developed countries and only 10% are worked in developing countries [Sengupta, Tamali—*Protection of Intellectual Property Rights In India And South Korea: Case Studies Of The Computer Software And Pharmaceutical Industries*, 1991].

that being used in the recipient country. This temptation will be further compounded by the presence of asymmetric information in favour of the developed country parties. Specifically, two factors could be at play:

Moral hazard. Moral hazard may be defined as actions of economic agents in maximising their own utility to the detriment of others in situations where they do not bear the full consequences or, equivalently, do not enjoy the full benefits of their actions due to uncertainty and incomplete or restricted contracts which prevent the assignment of full damages (benefits) to the agent responsible.[7] Developed country agents have full information about the technology they are supplying, while those in the developing countries cannot observe this costlessly. This enables the former to increase their profits by supplying technology of a previous generation to the detriment of the latter.

Adverse selection. Since developing country agents do not have complete information, they form their expectations by observing the range of quality of technology supplied in the market. They attach probabilities to getting different qualities of technology. Using these probabilities they determine the expected value of the technology being offered. The price they are willing to pay will lie between that of the most and least advanced technology being offered. At this price the developed country agents will not find it profitable to sell the advanced technology as the price the developing country agents offer will be less than what they expect. The iteration of the above phenomenon will result (in the extreme case) in only previous generation technology being offered in the market.

The implication is that from both the supply and the demand side, the market tends to move away from the state-of-the-art. While this may be relatively inefficient from the point of view of minimising GHG emissions (since the potential of the continuously changing state-of-the-art to contain such emissions may exceed that of the second best), it may be optimal in the context of maximising global welfare. This is because in some cases, the developing countries themselves might prefer a second best technology to the state-of-the-art, since the former may be more appropriate for their economies. (See next section for further details on this argument.)

Technology transfer is multi-dimensional. It can be categorized into three broad areas:

- actual level of know-how transferred—this spans the transfer of intellectual capital (blue-prints), physical capital, and final products
- the property rights over the technology transferred
- the nature of compensation (licence fees, side commodity deals, etc.) involved in the transfer

The Convention is silent about depth of technology transfer. This ambiguity leaves considerable room for the developed country agents to manoeuvre the interpretation to maximise their gain at the expense of the developing country agents. The result could again be either the transfer of outdated technology or transfer in a very narrow framework. For example, such transfers may comprise only exports of the commodity embodying the technology, rather than the blue-prints or the physical capital needed to produce that commodity. This would leave the recipient country with no feasible option other than a continuous import of the commodity in question.

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[7]Eatwell, John, Murray Milgate and Peter Newman (ed.)—*The New Palgrave: A Dictionary of Economics*, Macmillan Press Limited, 1990.

Obviously, this involves significant opportunity costs for the recipient due to the continuous outflow of foreign exchange. Furthermore, the developed countries could also step up pressure on developing countries to change their existing IPR regimes if any transfer is to go through.

B. Suiting this know-how to the economic and social systems of the developing countries

The advent of the debate on Global Warming has brought forward many persuasive arguments for switching to 'clean' coal technologies such as the IGCC (Integrated Gas Combined Cycle). India set up a couple of pilot plants by importing gasifiers from Germany and USA. However, in field conditions in India it is found that the efficiency of the gasifiers was much less than that achieved in Germany/USA. This is because the gasifiers being used were developed for high quality coal whereas, Indian coal has a very high percentage of ash, clay and other extraneous matter.

The above example shows that the characteristics of technology are determined largely by the nature of economies for which they are designed. The most significant determinants are:[8]

- level of income in the economy
- resource availability and relative factor costs
- nature of the technology in use in the society
- system of organization of production in the society for which the technology is designed

Therefore, the characteristics required of any (new) technology differ sharply between developed and developing countries. Appropriate technology is that which minimises economic costs given the resource base and other socio-economic conditions prevailing in the country. Thus, the state-of-the-art technology from developed countries may be inappropriate for developing countries and could lead to inefficiencies in these economies. It could, for example, lead to relatively abundant resources like labour being underutilized. It is precisely for this reason that developing countries may prefer a previous generation technology to the state-of-the-art.

This aspect has not been explicitly dealt with in the Convention. Perhaps a clearer elucidation of 'agreed full incremental costs' that provides for the costs of adapting technologies to recipient economies is required to cover this aspect of technology transfer.

Another possible way around is joint R & D. Since the developing countries constitute a large part of the market for environmentally sound technology, leaders in such technology could start flagship R & D projects on a large scale in these countries catering specifically to their needs. The Convention says:

> ' ..... developed country parties shall support the development and enhancement of endogenous capacities and technologies of developing country parties'. [Article 4(5)]

However, joint R & D may not be in the interest of developed country agents as it could jeopardize their present monopoly over such technology. Therefore, a mutually satisfactory way to share IPRs will need to be devised, so as to provide sufficient incentives for such undertakings.

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[8]As identified by Stewart in Meier, 1989—*Appropriate Technology*, in Leading Issues In Third World Development, (4th ed.), Gerald M. Meier (ed.), Oxford University Press, New Delhi, 1986.

C. Overcoming resistance to technology change in developing countries

Resistance to technical change exists mainly for two reasons. Firstly, there are infrastructural requirements associated with certain types of technologies. For example, setting up electronic telephone exchanges requires that equipment be kept in air-conditioned rooms. The absence of this facility in developing countries (due to erratic or non-existent power supply) discourages the establishment of such exchanges in rural areas. Secondly, a sizable portion of the population in most developing countries tread the thin line between subsistence incomes and starvation. This makes them highly risk averse and unwilling to use new techniques.

The significance of these factors lies in the fact that developing countries cannot thrust acceptance of new technologies on their people without substantial political and economic costs. In reality, using new, environmentally sound technologies could be painful. Therefore, unless sufficient measures are taken to provide

- insurance against the users lot being worse off than what it was before using the new technology
- education about the advantages of using the new technologies,

the proposed technology transfer could be ineffective. Once more, an appropriate definition of 'agreed full incremental costs' which covers such implicit costs could be used to provide the resources which may help overcome this resistance.

The Framework Convention and the macro economy

Since the Climate Change Convention is aimed at stabilising GHG emissions at a 'sustainable' level, benefits (in the form of adaptation costs foregone) will accrue to all generations of humankind. However, achieving this inter-generational equity objective could impose considerable costs on the present generations.

The Convention implicitly recognises the historical responsibility of developed countries for the current levels of anthropogenic emissions of GHG. It envisages a transfer of technology and financial resources from developed to developing countries, either in the form of grants or loans on concessional terms. The need for global action and the realization that the developing countries will not agree to take preventive measures if they interfere with their development process, together imply that mitigating climate change is a process of give and take.

Currently developed countries have a monopoly over environmentally friendly technologies. By transferring these to the developing countries they are effectively expanding the market for these technologies. A large part of the resources will flow back to the donor country in the form of demand for the goods produced by its firms and royalty earnings. The economic rent earned by any firm that enters a new market for such a technology will provide the wherewithal for further risk-bearing and innovation. Thus the firm will be able to gain a competitive advantage over the others in the industry. In a nut shell then, the aim is to gain a head-start in the future, Developed countries, therefore, stand to gain economic (and political) advantage in the domestic and international economy.

On the other hand, developing countries are aware of the importance of green lobbies in developed countries. They may thus see this as an opportunity to gain access to state-of-the-art technology. It is generally believed that though developing countries are labour abundant they are severely constrained by the availability of investable capital. The Convention may therefore be seen as a means for mobilising external resources to be used by the developing countries in their overall development effort.

Thus it may be argued that the influx of capital under the aegis of the Convention will supplement scarce domestic resources of the developing countries and therefore push/pull them out of their current stagnation. While this may be theoretically correct, in reality it is rather simplistic. One must examine the macro-economic effects of the likely resource transfer given the socio-economic conditions prevailing in developing countries.

Picture a typical developing economy. It is characterised by the presence of a large agrarian sector, a high population pressure on resources, high levels of unemployment, high rates of inflation, declining productivity, sticky interest rates, apart from a huge external debt and low levels of social indicators (such as per capita income, literacy rates, etc.).

New technologies that enter the economy are typically designed in developed countries. They are likely to have a long 'learning period' while they adapt to the economic conditions prevailing in the recipient developing economy. During this period the cost of production in the industries receiving these technologies will rise as shown in figure 2:

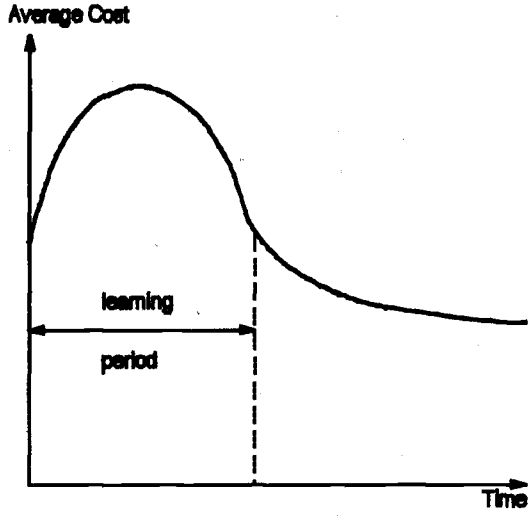

Figure 2

This figure shows the time profile of the average (social) cost curve of a firm that receives a new technology. Initially, the average cost to produce a given level of output will rise. However once the technology is endogenised the cost begins to fall and finally levels off.

In so far as a large part of the environmentally friendly technologies are likely to be concentrated in the energy and other industries with significant forward linkages, this higher cost will be transmitted throughout the economy.

At the same time, in each subsequent period there is an additional demand for capital—partly to finance the continuing capital formation and partly to consolidate the market (i.e., strengthen the demand) for the commodity embodying the new technology. This is more so in the case of environmentally benign technologies in developing

countries, where a market for them may not exist at all since the global environment is not a major consideration in these countries. Therefore, for the resource transfer envisaged under the Convention to be effective, it is required that costs incurred to undertake such measures are also covered. The reason for this is that the developing countries are unlikely/unwilling to raise these resources domestically, given their generally stagnating economies and the political unacceptability of increased taxation. However, there seems to be nothing in the Convention that ensures such a broad resource flow. On the contrary, this has been left open to debate and negotiation. Given the prevailing international power structure in the world today, it seems unlikely that such a broad flow will emerge. The only option left open to the developing countries will be to increase money supply—either by printing more money or by obtaining additional funds internationally from outside the Convention.

To the extent that the transfer of resources to the developing countries will be in the form of aid (albeit on concessional terms), as against outright grants, there will be additional costs incurred by the developing countries. This is because past experience has shown that the bulk of aid is 'tied'. This tends to distort the pattern of investment towards those projects that have a large import component rather than projects/ programmes which are primarily dependant on local resources, thus imposing opportunity costs on the recipient country.[9] Even if aid is not tied, there is scope for cartelisation in the supply of benign technologies, leading to 'reverse' transfers of economic profits from the developing to developed countries. But, perhaps the greatest cost to the recipient country, in our case a developing country, accrues when it has to furnish interest and amortization payments. Given the stagnation and low/declining productivity in the developing countries, additional nominal flows need to be generated to finance these payments. The result is a further impetus to the on-going inflation. Moreover, to the extent that the developing countries may have to borrow in the international loan market to make the above payments, they will be pushed further into the aid-debt spiral.

There are also other indirect costs associated with increased environmental aid. Firstly, since such aid is to be 'new and additional' i.e., in addition to the other development aid that the developing countries receive, it implies worsening of the debt-service ratios for the developing countries. The result will be a decline in their credit worthiness in the international aid/loan market. The implications of this could be far reaching as it might mean less and/or more stringent aid to the developing countries thereby jeopardising their overall development programme. Secondly, all interest and amortization payments have to be made in an internationally acceptable currency. Consequently, this places a strain on the foreign exchange reserves and (in a regime of flexible exchange rates), exchange rates of the debtor country. The resulting deterioration in the terms of trade may lead to an increasingly adverse balance of trade. This is because developing countries exports typically have low price elasticities and the relative decline in the price of exports will not be offset by a more than proportionate increase in the quantity exported. Quite apart from this, in so far as the (positive) gap between the domestic inflation rate and the world average is increased,

[9]Since some of the resources under the Convention may be transferred through bilateral arrangements, aid may be tied by source also. This too has obvious opportunity costs for the recipient country which might be able to obtain similar technology on much easier terms from another source.

there is a loss of competitiveness in the international market for exports from developing countries.

The Rio Declaration invokes the Polluter Pays Principle for meeting the costs incurred in undertaking abatement measures. Since the Declaration contains the guiding principles for all other documents emanating from the UNCED process, it is applicable to the Climate Change Convention. To this extent, the resource transfers could be interpreted as 'polluter dues'. This could imply that a significant portion of these transfers could be made in the form of grants or at least on more concessional aid. Furthermore, the 'tied' component of the aid could also be lessened. These changes could appreciably alleviate some of the costs incurred by the developing countries (as discussed above).

Thus, while it may be possible to establish an international Climate Fund it is essential to disburse these funds in a manner that assists the developing countries in limiting GHG emissions without exacerbating existing international and domestic inequalities. What is important is the efficacy with which the resources transferred under the Convention are integrated into the overall development effort of the developing countries. The governments of these countries will have to mobilise their own resources and implement complementary programs that enhance the productivity of their economies so as to prevent environmental aid from being detrimental and to realise the full potential of the incoming technology and financial resources.
In recent years many developing countries have embarked on programmes of structural adjustment of their economies. It will be crucial how these countries can integrate these environmental considerations into their policies or national strategies. The structural adjustment can be complimented by these new technologies and resources making the transition a smoother process.

Trade and environment: a case for protectionism?

There has been increased awareness in recent years about the need for a cleaner environment, and a growing realisation that using products produced by environmentally friendly production processes is an important way of achieving this. This has created an international 'green market', in both products and technology. Trade can help exploit this market. Countries such as Germany and Japan have come to realise that an 'early first' comparative advantage can be gained in the not so distant future by adopting more stringent environmental standards now, as they feel the world will follow suit soon. Besides, there is political mileage to be gained by being world leaders in environmental issues as there is reason to believe that other countries will not let the green market/constituency go uncompeted for.

However, trade also creates disincentives for the protection of the environment. Most environmentally benign technologies have high capital costs (though they may have positive net present values). Therefore, in the short run this results in a loss of competitiveness for their users in an international scenario where not everyone is using such technologies. In the same spirit, relatively lax environmental standards in a country provide an 'ecological subsidy' to its industries making them more competitive than those in countries with more stringent standards. This might result in the shift of production to these 'dirty' countries to the detriment of the environment.

The protection of the environment has thus provided a rationale for tariff barriers or imposing unilateral trade sanctions. By keeping out commodities that do not

meet domestic environmental standards countries can provide protection to their own industry against potential competition.

Conversely, when sanctions are imposed for other economic reasons, such as the protection of inefficient domestic industries, these can work against the environment. For example, a protected agricultural sector based on the intensive use of chemical fertilisers prevents entry of like commodities from other countries with lower fertiliser intensities. The by-product of this protection is a higher emission of GHG by the protecting country, (and also an increase in other local pollution impacts).

Also, there may be differences in perception of the risk posed by a polluted (global) environment. This divergence in perceptions, especially marked between developed and developing countries, is reflected in a lower willingness to pay for its cleaning up and therefore, in a lower social cost in the latter countries. Thus, even if countries have similar environmental standards, these may be met at markedly different costs. This difference in costs could be perceived as another ecological subsidy for industries in the developing countries. This provides an incentive to the developed countries to impose countervailing measures.

Recognising the potential for protectionism the Climate Change Convention has made the following provision:

> ' The Parties should cooperate to promote a supportive and open international economic system.....Measures taken to combat climate change, including unilateral ones, should not constitute a means of *arbitrary or unjustifiable discrimination or a disguised restriction* on international trade.' [Article 3(5)] (Italics added)

It is interesting that the italicised phrase also appears in the GATT (General Agreement on Tariffs and Trade) under article XX.[10] Thus, the inclusion of the phrase could be an effort to harmonise/reconcile the Convention and GATT. In this, the Convention is one of the few international agreements on the environment that prohibits the use of trade barriers. There are, however, some problems that might persist.

Most of the cases relating to the abuse of the environment that have been struck down by a GATT panel have been related to either local resources lying within a country's national jurisdiction and/or concern environmental resources not protected an international agreement. In the case of global climate change we are faced with a diametrically opposite situation. The issue at hand is one of transboundary pollution of a protected global common. Thus if a future protocol to the Framework Convention were to allow the use of unilateral trade sanctions or other barriers as an explicit (rather than a disguised/unjustifiable) enforcement mechanism against violations of obligations, these might be upheld by GATT, as an exception to the other GATT requirements that all members treat imports and domestically produced commodities in a like manner, as

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[10]Article XX relates to general exceptions. In particular, it provides for the following:

Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries ....., or a disguised restriction on international trade, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures:.....

(b) Necessary to protect human, animal or plant life or health;

(g) Relating to conservation of exhaustible natural resources, if such measures are made effective in conjunction with restrictions on domestic production or consumption;.....[Genaral Agreement on Tariffs And Trade—*The Text Of The General Agreement On Tariffs And Trade*, GATT, Geneva, July 1986].

also all trading partners. Failing this, a GATT waiver can be requested, especially if the signatories to the proposed protocol are mostly GATT members.[11] In fact, in the context of climate change, the use of waivers would ensure that the trade measures are focused on the issue at hand, are transparent and are multilaterally negotiated.[12]

This brings us to the question of whether the environment can be protected without resorting to outright protectionism. Alteration of consumer preferences in favour of environmentally friendly products, in other words, strengthening the green market, is one possible way. Suppose country X has achieved such an alteration through public awareness campaigns. Also, the domestic policy of this country is to label all commodities, whether imported or produced domestically, that meet certain minimum environmental standards. (This would not be GATT-illegal as imports from any source and domestic production are treated identically). In this case, even though a trading partner using environmentally less efficient production processes is allowed to enter the domestic market of X, it likely to suffer a loss in market share in this country. This is because, ceteris paribus, the demand for unfriendly products has reduced. Here, the alteration of consumer preferences in favour of a differentiated product has created market incentives for protecting the environment without being GATT illegal.

Implications for future protocols

For an agreement to be successfully implemented, it is important for it to be self enforcing. The problems faced in the implementation of international agreements (such as the Climate Change Convention) are typified by the Prisoners' Dilemma. If all parties to the agreement abide by their commitments they maximise their joint payoffs. However, individually, their interests are best served by a strategy of violation. Therefore, the dominant strategy for each party to the Convention would be to continue emissions of GHG above the agreed levels by not signing future protocols to the Convention.

An ideal way (in a Game Theoretic framework) to implement any future protocol to the Convention would be to alter the payoffs in the 'emissions game' so that stabilising emissions at the agreed levels becomes the dominant strategy. This alteration could, however, involve the use of harsh measures such as trade sanctions, reduced financial assistance, etc, which may discourage many nations from signing on. In international agreements, therefore, it sometimes pays to leave the protocols to such Conventions somewhat vague so as to get more nations on board. On the other hand, there might exist positive measures that change the pay-off matrix in a manner that makes every one better off by signing the agreement. Tradeable permits may be one such instrument. Countries that exceed their allotted levels could purchase the right to emit from those that have a surplus of emission rights. This would provide an incentive to both parties. The excess emitters could continue their emissions above the allowable level while countries with lower emissions can generate resources through this mechanism. At the same time, the increasing imbalance between the demand and supply of these permits that is likely to occur as an growing number of (developing)

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[11]To obtain a waiver under GATT a two thirds majority of the votes cast is required, with the additional requirement that these two thirds comprise more than half of the contracting parties.

[12]Genaral Agreement on Tariffs And Trade—*International Trade 90-91 (Vol. 1)*, GATT, Geneva, 1992.

countries increase their emissions in their pursuit of development will raise their price, which would create incentives for increasing GHG efficiency.

That protocols to the Climate Change Convention will be incomplete contracts should be kept in mind. The writing of a complete contract will be particularly difficult in this case due to the following reasons:

- protocols would involve complex transactions and long time periods—this will make writing detailed contingent contracts very costly.
- there is a high degree of scientific uncertainty in the Climate Change debate—this is largely due to the large number and complex nature of possible eventualities. Hence, contracting for each possible outcome is a virtual impossibility.

The implementation of an incomplete contract might be hampered by the non-existence of a strict enforcement mechanism. This absence does not necessarily imply that the contract is doomed to failure. There exist forces outside the protocol (such as public opinion, international political pressure, etc.) that can ensure its effective implementation.

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UNEP greenhouse gas abatement costing studies

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Introduction

Many approaches have been taken to estimating the cost of limiting GHG (Greenhouse Gas) emissions. These have used a variety of different assumptions and/or methodologies, and consequently the results of one are difficult to compare with the results of another. The UNEP Greenhouse Gas Abatement Costing project is intended to clarify the economic issues involved in assessing the costs of limiting greenhouse gas emissions and to propose approaches for carrying out comparable costing studies.

The UNEP Collaborating Centre on Energy and Environment at Riso National Laboratory, Denmark co-ordinates the project, with assistance from the Tata Energy Research Institute, India and Caminus Energy Ltd in Cambridge, UK, Dr Michael Grubb of London's Royal Institute of International Affairs, a Special Adviser to the Executive Director of UNEP on these issues and co-ordinator of the earlier workshops, is the lead adviser and liaison to the Executive Director for the project.

The project is divided into two phases of which the first is now completed (UNEP, 1992). The first phase consisted of detailed studies of the underlying issues in estimating abatement costs, including analysis of modelling options and reviews of existing cost estimates, and a small set of national reviews. These country reviews aimed at establishing the status of analysis and data in the countries concerned, and illustrate in depth the practical issues raised in embarking upon abatement cost studies in widely diverse countries. Drawing on this experience, Phase One of the project forms the basis for establishing a consistent and iterative approach to national abatement cost studies.

The aim of Phase Two is to develop and test a methodological approach through a set of national case studies. As far as possible, these studies should use common (or compatible) assumptions for parameters like international fuel prices, discount rates, emission factors, and general technological development within the energy sector. In addition, the structure of the analysis (e.g. time horizons and degrees of abatement considered) and the concepts of cost used are defined to allow maximum comparability.

An essential feature of the case studies will be the combination of the results of bottom-up (engineering) models, used for detailed system modelling of GHG abatement scenarios, with short to medium-run macroeconomic models, in order to calculate the total macroeconomic effects of such strategies. This will involve improvement and utilization of the methodology of GHG-reduction cost curves.

Project participation

The project aims to cover a range of countries in different stages of development, in different geographical regions and with different energy options. At the inception of the project it was envisaged that funding of the central project team would be directly from UNEP, while the country studies would be self financed in the case of developed countries, or funded by donor agencies in the case of developing countries and economies in transition. In the latter cases a pairing arrangement was proposed whereby

institutions in the donor and receptor countries could collaborate. In view of the relatively rapid initiation of the project, only a small core of countries were able to participate fully in the first phase, while a number of other countries were more loosely associated. These countries, and others, will join the project at a later stage as funding is secured.

The countries participating in Phase One were Denmark, India, the Netherlands and Zimbabwe. Summaries of the country studies are presented in the Phase One Report (UNEP, 1992) and the full country papers are available on request from the UNEP Collaborating Centre on Energy and Environment.

The four core countries exhibit quite different stages and approaches to the treatment of GHG abatement costing. The two developed countries, Denmark and Netherlands, in spite of similar size, geographic situation, industrial and residential structure, etc., have chosen different approaches. The two developing countries, India and Zimbabwe, constitute two very different examples, both in terms of physical size and energy systems and in the development of methods. Energy modelling and GHG costing methodologies are well established in India, while the process is still in its infancy in Zimbabwe.

Relation to the Climate Convention

The Framework Convention on Climate Change (UN, 1992) lays considerable emphasis on issues of cost. The precautionary approach is accepted, subject to the caveat that measures adopted should be 'cost effective'. This is not defined, but clearly questions relating to the economic cost of limiting emissions (as well as the benefits of not doing so) will be crucial to the future policy debate. Furthermore, the convention focuses upon 'Incremental cost' in relation to the transfer of financial resources for GHG abatement in the developing countries. 'Incremental cost' is not defined in detail in the climate convention, but can be understood both in relation to project implementation and to more general economics of total abatement strategies.

There are a number of potential definitions of 'cost' and 'incremental cost'. Other studies under way are attempting to clarify appropriate definitions for use in relation to the convention. There are also extensive debates about how to quantify the benefits to be gained from limiting emissions.

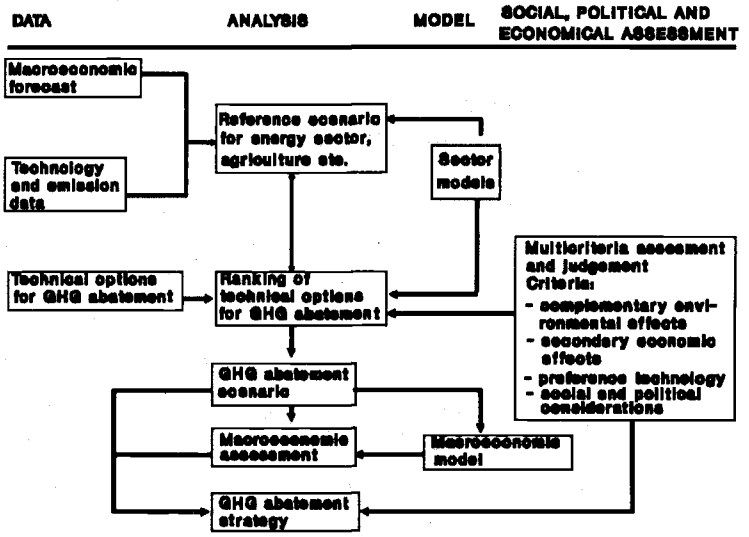
The project does not seek to resolve the debates about appropriate definitions of cost and incremental cost for use in the international context. Nor does it consider quantitatively the climatic benefits of abatement, because of the immense uncertainties and complexities surrounding this. Instead, the project seeks as the primary focus to examine how the impact of varying degrees of abatement on key cost indicators can be assessed, in ways which both command broad consensus as providing reasonable indications of the costs involved in limiting emissions, and which can be practically realised in relation to the available models, data and institutional capacities in the countries involved.

Content and structure of the studies

To gain maximum benefit from abatement costing studies, they need to be structured in a comprehensive and logically consistent manner. The principal aim of Phase Two of the UNEP studies is to conduct a set of representative national studies within such an approach. The proposed methodological structure is outlined below.

The proposed GHG abatement costing analysis can be briefly summarized as follows.

1. Establish a reference scenario on the basis of the best available national macroeconomic forecast, technology and emission data. An energy system model (and possibly other sector models) is required in this step.
2. Specify a set of relevant GHG abatement technologies and make a separate direct cost and emission ranking of these compared with the reference scenario. Supplement the 'pure' cost and GHG emission criteria with other relevant social, political, and economic criteria.
3. Analyze a set of comprehensive GHG abatement scenarios using a total energy system model and other relevant sector models, in which all relevant linkages in the production system can be treated.
4. Assess the macroeconomic impacts of the different GHG abatement scenarios derived in the previous step. At this stage some additional scenarios may be developed and analyzed using the sector models.
5. Comment on the desirability and social, political and economic consequences of one or more alternative GHG abatement strategies.



The approach is a compromise between different qualitative concerns and is therefore naturally open to criticism, both from experts who may find it too simplistic, and from others who might find it over complicated and demanding. This is an inevitable risk for any activity of this type. It is important to stress that the project team does not claim to have found the ultimate method, which in our view does not exist. The effort merely represents a first attempt to move the international debate on these issues towards a broader and more common understanding.

Future plans

As mentioned above a number of countries are expected to join the project for Phase Two. These include Argentina, Australia, Brazil, Egypt, Senegal, Thailand and Venezuela. Funding is already secured for some of these and the country studies are under way. The inclusion of these countries, and possibly more, in the project, carrying out comparable national studies of the cost of greenhouse gas limitation will provide valuable information on the feasibility of a common approach. A possible third phase would extend the approach to an even wider group of countries, concentrating on the establishment and consolidation of local expertise in the assessment of such costs.

The second phase of the project is scheduled to be completed in June 1993. A third project workshop for participating countries and the project team will take place in New Delhi in February 1993. The completion of the project as a whole will be marked by a major symposium 'National strategies for Limitation of Greenhouse Gas Emissions' with special emphasis on costing, tentatively scheduled to take place in Denmark in October 1993.

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Energy and environment: post-UNCED

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Abstract

After nearly 20 years of global energy studies emphasis has shifted from resource limits and volatile prices to the increasing recognition of environmental issues as important driving forces for present and future energy systems. In view of concerns about energy-related sources of global change, as documented by the UNCED process and the Framework Convention on Climate Change signed in Rio, the paper discusses transitional strategies and policy measures that achieve economic and social development goals while minimizing emissions of greenhouse gases such as CO_2. Environmentally more compatible energy strategies encompass a wide range of techno-economic adjustments such as efficiency improvements and shifts to low and carbon-free fuels on one hand, and institutional and social-behavioral responses on the other. The paper illustrates ongoing research at the International Institute for Applied Systems Analysis (IIASA) to develop analytical tools for the assessment of policy options that respond to the agenda set forward by UNCED and which is likely to remain a planetary one for much of the 21st century.

Introduction

Traditional concerns about the physical and economic availability of adequate energy resources have given way to increasing awareness of global and long-term environmental impacts of energy production, conversion and end-use at all scales from the local, regional, to the global level. Today, the predominant question is still whether it would actually be possible to continue consuming fossil energy at current or even higher rates in the future? What is new is that instead of available energy resources the risks of adverse global change could constitute the ultimate limit of future development in energy systems. Thus, the ultimate global resource could be the environment rather than recoverable energy reserves and resources.

Since the onset of the Industrial Revolution, humanity has consumed fossil energy amounting to some 200 Gt (10^9 tons) carbon and current annual emissions from fossil energy use amount to almost 6 Gt carbon (C). Compared to this, our remaining 'carbon wealth' accumulated over geological times is orders of magnitudes higher. Currently identified, economically recoverable energy reserves amount to 540 Gt C (Table 1). Additional 3026 Gt C are contained in resources (i.e., identified quantities, whose economic recoverability is uncertain at present) and further 5200 Gt C are contained in additional occurrences (quantities inferred by broad geological information but with their economic and technical potentials remaining largely unexplored). Remaining fossil energy resources thus range between 3500 to 8700 Gt carbon, compared to a current atmospheric carbon loading of about 760 Gt. This clearly illustrates that already currently known fossil energy resources could be sufficiently large to increase atmospheric CO_2 concentrations by several factors. This raises the issue of how necessary further economic and social development could be achieved without undue stresses on the global environment and how the burden of mitigation or

adaptation measures is going to be shared considering historical and present disparities in energy-related carbon emissions (Figure 1).

In order to assess possible and likely future trends in the energy sector, Stanford University and IIASA have been jointly organizing since 1981 the International Energy Workshop (IEW) (cf. Manne *et al.*, 1991) with the aim to compare energy projections made by different groups in the world and to analyze their differences. The median of global CO_2 emissions calculated from the IEW polls of global energy consumption or, in our interpretation, the current 'consensus view' of the future, corresponds to an annual growth rate of one percent per year, i.e., to an increase from about 6 Gt today to some 9 Gt carbon by the year 2020, with a range between 8 to 10 Gt as shown in Figure 2. By comparison, 'business-as-usual' scenarios such as elaborated within the Intergovernmental Panel on Climate Change (IPCC) or by the US EPA (1990) project emissions in the order of 10 Gt carbon by the same year, which indicates that these scenarios might perhaps be better considered as 'high emission growth' scenarios. Additional concern has been voiced (Parikh, 1992) in terms that the IPCC scenarios may in appropriately project current inequalities of resource use and resulting anthropogenic sources of global change far into the future.

Alternative baseline projections relying on a continuation of historical trends in energy efficiency improvements and structural changes in energy supply towards environmentally cleaner fuels indicate somewhat lower global emissions, but nevertheless an increase, primarily the result from continuing economic development in the South. Examples of the latter type of scenarios include the reference scenario developed by the World Energy Council (WEC, 1992) or scenarios developed at IIASA like the ECS'92 scenario (Nakicenovic *et al.*, 1993) or the global reference scenario aggregating national CO_2 abatement costing studies performed within the CHALLENGE network (G2100 scenario), as shown in Figure 2.

All prevailing trends depicted in these scenarios suggest that—in the absence of appropriate countermeasures—global carbon emissions will rise, perhaps beyond environmentally acceptable levels. If indeed limitations on carbon emissions (either of absolute levels or at least of their rates of increase) will become integral part of future national and international energy environmental policies, two questions will need to be addressed by both the analytical and the policy communities, e.g. in possible negotiations on protocols of the Framework Convention on Climate Change:

1) What could be possible criteria to share the burden of global mitigation efforts, and what could be possible mechanisms to implement such burden sharing in an equitable and cost-effective way?

2) By what technological and regulatory measures are emission reductions to be achieved and what are appropriate policy instruments for their implementation both nationally and internationally?

Figure 3 illustrates some of the salient features of limiting energy-related CO_2 emissions globally in comparing OECD versus developing countries (DCs). 1990 emissions and a scenario for 2020 based on the ECS'92 base case scenario (cost optimal solution without any emission constraints) provide the starting point for the analysis. Note in particular the stabilization of emissions in the OECD region (primarily result of continued improvements in energy efficiency and decarbonization of energy supply) and a near tripling of emissions in DCs (primarily result of vigorous economic growth and comparatively modest efficiency improvements). For an illustrative scenario of stabilizing global emissions by 2020 at 1990 levels, three alternative burden sharing

models[1] discussed in the literature and also raised during the negotiating process for the Climate Convention are shown in Figure 3. In one case (grandfathering) the burden of emission reduction is shared uniformly across all regions via a 35% flat rate reduction. Alternatively, emission reductions are allocated according to differentiated responsibility in CO_2 concentration increase (cutbacks proportional to historical contribution), whereas a third model does not allocate emission reductions, but rather the access to the global commons in form of equal per capita emission entitlements by 2020. An illustrative carbon tax case (170 $ per ton carbon in OECD and half that rate in DCs, cf. Messner and Strubegger, 1991) illustrates what level of reductions could be expected by such a range of emission taxes (increasing energy prices by up to 100%). This kind of analysis also indicates that conventional economic policy tools could accommodate emission reductions based on status quo considerations, whereas alternative formulations would require some new mechanisms (such as international trading of emission allowances/permits) to allow for macro-economic (and global) cost effectiveness.

Thus, perceptions about factors ultimately limiting future energy and resulting emission growth have changed from resource to environmental scarcity while the driving forces are still the same population and economic growth. Some of the measures and strategies that seemed to be desirable in the past, however, are invariant to this shift in perceptions. Efficiency improvements and conservation are instrumental in reducing both fossil fuel requirements and emissions. In addition, structural changes in the energy system towards environmentally compatible energy carriers, and low or even zero emission technologies represent additional response options to the risks of global change.

IIASA research on energy—environment interactions

An IIASA study on Environmentally Compatible Energy Strategies (ECS) develops an analytical framework to evaluate policy options and future global energy strategies directed at delaying or mitigating global change. In particular, the objective is to assess future potentials and rates of reducing energy and carbon intensities worldwide. Figure 4 shows historical improvements toward improving energy efficiency and decarbonization in a number of selected countries. The aim is to analyze future trajectories that would lead individual countries and the world as a whole further toward the origin of Figure 4 . Whilst the historical trends depicted in Figure 4 are indeed encouraging, they nevertheless have been insufficient: long-term improvements in energy efficiency and decarbonization combined have been proceeding at rates of 1.3 percent per annum, whereas economic activity has grown with rates of about 3 percent per year. Hence, global energy-related carbon emissions have risen at a rate of about 1.7 percent per year. All this implies that historical improvement rates in energy efficiency and decarbonization have to be significantly accelerated to slow the rates of emission increase.

IIASA's ECS Project is developing a comprehensive assessment of a broad range of options (technologies, associated economic incentives and institutional

[1]For a discussion and comparison of burden sharing models see Fujii, 1990; Grubler and Fujii, 1991; and Grubler and Nakicenovic, 1992. A data base of historical emissions combined with a range of allocation models in parametric form is being developed at IIASA to allow quantification of the implications of using different models or varying other salient parameters of importance in greenhouse gas accounting.

frameworks for their implementation) that is needed for evaluating the global potential for stabilizing, and ultimately reducing emissions, perhaps even removing carbon dioxide and other greenhouse gases from the atmosphere. An important part of that work involves the development of an inventory (a data base) of technologies for reducing carbon dioxide emissions. The inventory provides a framework for the technology assessment of mitigation options, for their evaluation, and for comparison and exchanging data at the international level. Finally the inventory also provides input data into the energy models developed to achieve consistency in the comparisons across a wide spectrum of mitigation options. The second objective of IIASA's research is to identify constraints and boundary conditions of strategies for achieving environmentally compatible paths of economic and social development. The development strategies outline different paths of techno-economic, socio-behavioral and institutional adjustments reflecting differing technological, economic and cultural conditions of industrial market, transforming, and developing economies respectively.

Improving energy efficiency and decarbonizing the energy system

From the mitigation options available, improving energy efficiency is a particularly attractive one as serving simultaneously a number of objectives: improving the overall productivity of economies (producing more with less inputs) while at the same time reducing not only greenhouse gas emissions but also other environmental impacts. A long-term perspective shows that the frequently discussed 'decoupling' of energy demand from economic growth is not necessarily confined to periods of high energy prices. The primary energy input per (constant) unit of GDP generated for all OECD countries taken together has fallen at an average rate of two percent per year since 1973. If we take 1960 as a base year, improvement in energy intensity amounts to an average rate of one percent per year. A similar analysis performed for the USA (including non-commercial energy consumption) since 1800 shows a comparable long-term improvement rate (Nakicenovic *et al.*, 1990). This raises the question to what extent historical efficiency improvement rates can be maintained in the future.

A detailed energy/exergy efficiency assessment of the OECD countries indicates that the conversion from primary energy to final energy forms required by the consumer is about 70 percent. In contrast, the efficiency with which final energy forms are applied to provide useful energy forms and services is much lower resulting in an overall conversion efficiency of not much more than 10 percent. The efficiency of the system is still lower if different 'quality' characteristics of various energy carriers and delivered forms are taken into account. Figure 5 shows that the overall exergy (second law) efficiency in the OECD countries is at most a few percent compared with the theoretical maximum. This shows that there is large scope for more efficient energy use and in particular for improvement of end-use technologies. The inventory of mitigation measures and the technology data base being developed at IIASA are specifically designed to integrate current and possible future individual conversion, transport, distribution and end-use systems into energy (or exergy) chains giving whole bundles of technologies that define a particular reduction strategy.

The overall energy efficiency of the OECD countries as well as in reforming and developing economies would be doubled by application of the most efficient technologies available today (Nakicenovic *et al.*, 1993). The rates at which such efficiency improvements can be achieved are in turn to a large extent dependent on the

age distribution of the capital stock of our economies, rates of diffusion of new technologies and technology transfer. The long-term improvement in energy intensity of GDP was about one percent per year in the industrialized countries. However, this is a historical average over 200 years containing periods of more rapid improvement (2 to 3 percent per year), but also periods of stagnation and even reversals with increasing energy intensity due to the build-up of energy intensive infrastructures, as is the case today in a number of developing countries. Efficiency improvements have been faster in certain areas than in others. For example, over the past twenty years, aircraft manufacturers have managed to improve energy efficiency of commercial jet transports by 3 to 4 percent annually. In electricity generation, this improvement has been 2.5 to 3 percent per year over the period between 1930 and the early 1970s. These are about the upper boundary values to be expected in efficiency improvements in the medium term. With an improvement in the energy intensity of 3 percent per year, a dollar of GDP could be produced fifty years from now with only 20 percent of current energy requirements; this figure would be lower in terms of carbon emissions if energy substitution is also taken into account.

While efficiency improvements are a fundamental measure for reducing carbon emissions especially in the near to medium term, in the long run there is a clear need to shift to energy sources with low carbon content such as natural gas, and ultimately to those without carbon whatsoever, such as hydro, solar, and nuclear energy, and the sustainable use of biomass. Increased reliance on natural gas is a particular interesting transitional option (Ausubel *et al.*, 1988), especially in combination with active CO_2 recovery, e.g., from steam reforming (Marchetti, 1989). Thus, both technological and economic structural change will be of fundamental importance for efficiency improvement and for lowering carbon emissions in order to achieve environmentally compatible pathways of socio-economic development.

Technology assessment

The multitude of options available for improving energy efficiency and for further decarbonization of energy systems[2] need a systematic evaluation with respect to their ultimate potentials, costs involved, and possible diffusion horizon before conclusions on their desirability and applicability in different economic and social contexts can be drawn.

Such an evaluation constitutes the main part of an ongoing study within the Environmentally Compatible Energy Strategies (ECS) Project at IIASA. In order to make the technology assessment transparent and open to critical evaluation, the activity includes the development of an integrated database for a comprehensive inventory of technological options for mitigating energy related CO_2 emissions: the CO2DB. The database covers the full range of technological and economic measures spanning efficiency improvements, conservation, enhanced use of low-carbon fuels, carbon free sources of energy and other options such as afforestation and enhancement of carbon sinks.

The inventory of mitigation measures and the associated technology database are specifically designed to provide a uniform framework for assessment of ultimate impacts from the introduction of new technologies over different time frames and in

[2]For an overview see: Grubb *et al.*, 1991; IPCC, 1991; Kaya *et al.*, 1993; Nakicenovic *et al.*, 1993; Schafer *et al.*, 1992; US National Academy of Sciences, 1991.

different regions. The database includes detailed descriptions of the technical, economic, and environmental performance of technologies as well as data pertinent to their innovation, commercialization, and diffusion characteristics and prospects. Additional data files contain literature sources and assessments of data validity and concurrent uncertainty ranges. It is an interactive software package designed to enter, update, and retrieve information on energy technologies with emphasis on those offering opportunities for CO_2 reduction and removal. The database also enables the assessment of CO_2 reduction strategies by combining many individual technologies together, i.e., to analyze measures throughout the energy chain from primary energy extraction to improvements in energy end-use efficiencies often called full-fuel-cycle analysis. Thus, the CO2DB enables analysis of options encompassing whole bundles of technologies that define a particular energy or environmental strategy.

Figure 6 illustrates an analysis of the cost, CO_2 emissions and energy requirements of different energy chains that provide the same service—lighting. Each of the seven bars depicts a different combination of technologies that can now or could in the future provide lighting: conventional incandescent bulbs versus energy-efficient compact fluorescent bulbs; power generated by a conventional power plant burning hard coal versus a highly efficient combined-cycle natural-gas turbine, with or without CO_2 scrubbing. The last bar in each graph compares one of the six US energy chains with an identical chain in Austria: analyses using CO2DB show to what extent identical technological systems can have different costs and consequences in different situations. Figure 6 illustrates several other features of the CO2DB inventory. First, it depicts all parts of an energy chain. Second, it gives a breakdown of the costs and emissions attributable to each step in the chain: in these examples costs to deliver the same service differ by about 30 percent, while CO_2 emissions to provide that service differ by more than 90 percent. Third, it allows analysis of trade-offs: for instance, the potential to reduce CO_2 emissions by concentrating on energy end-use—in this case, the type of light bulb—versus energy supply, and the approximate costs of changing any part of the chain.

Environmentally compatible energy strategies

Four types of technological strategies can be distinguished for improving the environmental compatibility of current and future energy systems. The first is an incremental one, emphasizing energy efficiency improvements. In this case, devices or operational practices are replaced by more efficient ones without major changes in the technology of the device itself or technologies upstream of the energy chain. For example, this could mean replacing a refrigerator or a gas-fired power plant by more efficient vintages while using the same electricity and fuel supply chains. The other three strategies are more radical. They include changes in the design and operational practices of technologies with and without changes in the energy chains. We refer to these as changes in technological 'trajectories' . In the simplest case, the end-use technology is changed but keeps the same upstream energy chain, e.g., switching from a gasoline to diesel car. Alternatively, the end-use and conversion technologies may stay the same but the primary energy input changes, such as switching from a coal to a gas-fired combined-cycle power plant. Finally, it is possible to change the 'trajectories' of end-use, conversion and primary energy supply technologies, such as switching from a gasoline car with oil as the primary energy source to an electric vehicle with photovoltaic panels.

There is a clear ranking of the four different technological strategies with regard

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Fossil Energy Consumption, Reserves and Resources (Gt C)

	Coal	Oil	Gas	Total
1860–1987	114.9	58.2	24.5	197.6
1987	2.5	2.4	1.0	5.9
Reserves	391.6	92.1	58.5	542.2
Resources	2289	622	>115	3026
Additional Occurrences	>3500	>1000	>700	>5200

Table 1. Accounting for historical, present and potential future carbon emissions from fossil fuel use in Gigatons carbon. Historical (1860-1987) and present (1987) carbon emissions from fossil fuel use by source and carbon content; identified, economically recoverable fossil fuel reserves, resources (identified quantities with uncertain prospects of economic recoverability), and additional occurrences (additional quantities inferred from geological information but with speculative technical and economic potential). Compared to historical fossil fuel use, the remaining resources in the ground represent a (perhaps even far too large) "carbon wealth" which is more than a factor 10 greater than the total carbon pool in the atmosphere of around 760 Gt C (corresponding to a present CO_2 concentration of about 350 ppm). Source: Nakićenović *et al.*, 1993.

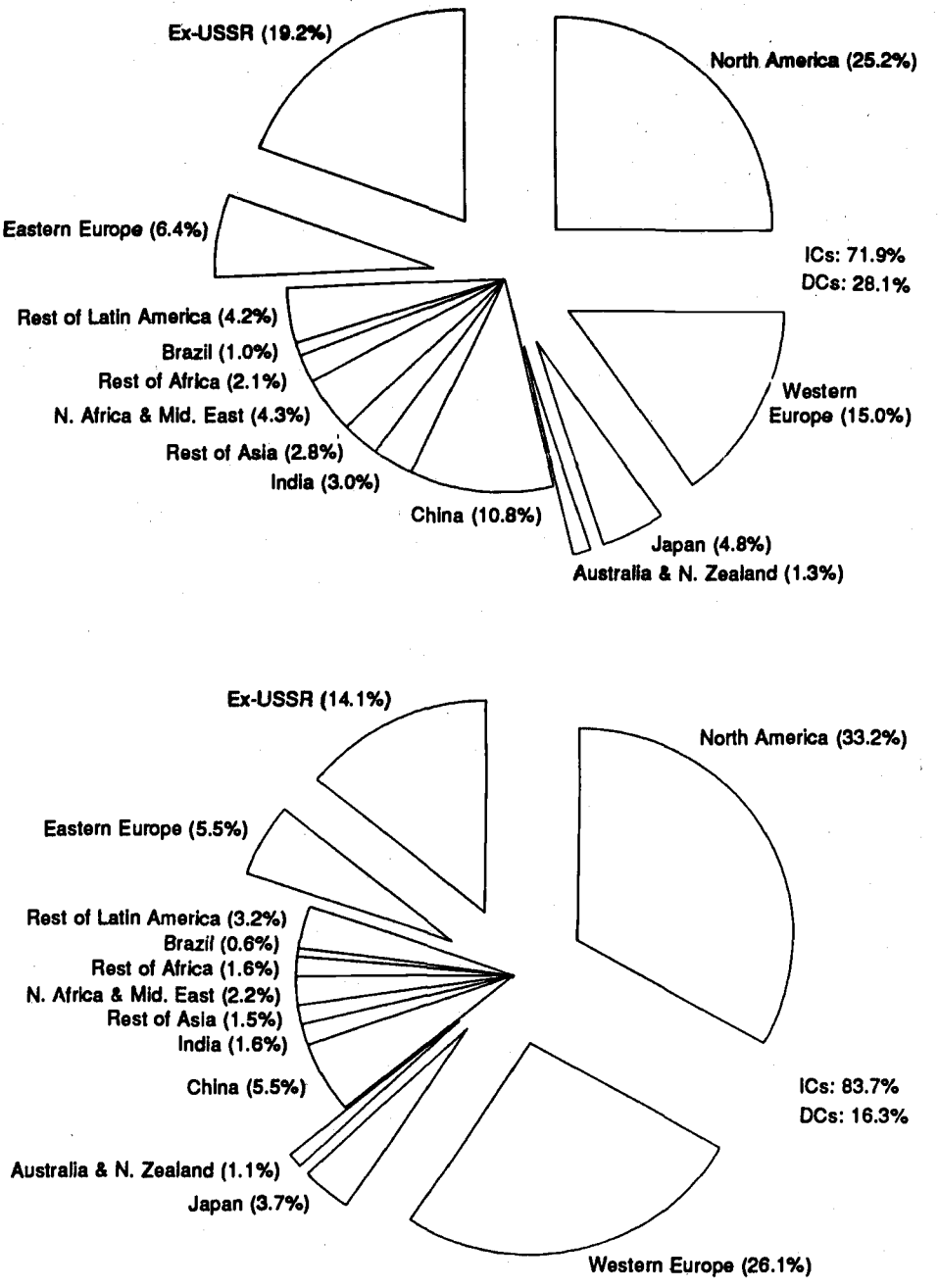

Figure 1. Distribution of energy-related CO_2 emissions by major world regions/countries (in percent), 1988 (top), and contribution to atmospheric concentration increase 1800-1988 (bottom), based on historical emission estimates and a simple carbon cycle model. Emissions include also other industrial CO_2 sources (cement manufacture and flaring of natural gas). Source: Grübler and Nakićenović, 1992.

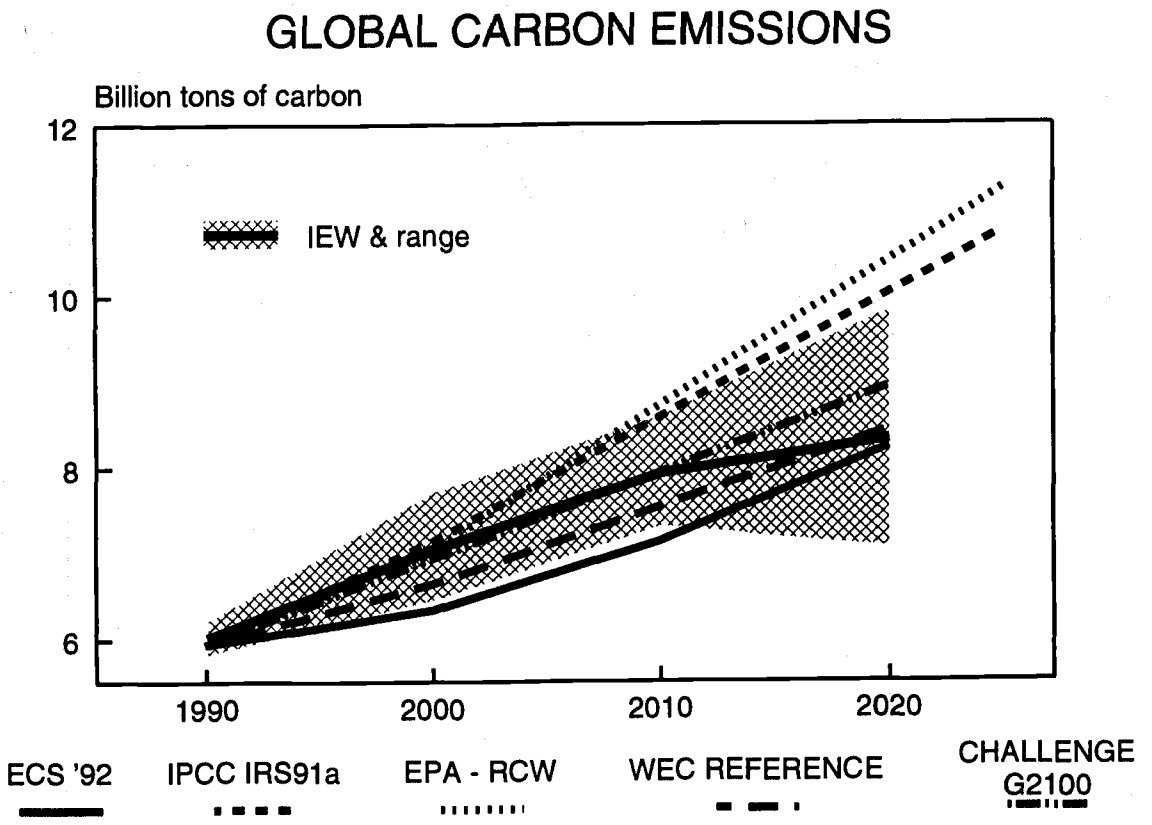

Figure 2. Range of scenarios for future global energy-related CO_2 emissions (in Gigatons carbon) as indicated by the International Energy Workshop (Manne *et al.*, 1991) poll-response median and range (± one standard deviation), and a range of scenarios: IPCC (1992), WEC (1992), EPA's (1990) Rapidly Changing World Scenario. Two scenarios developed at IIASA are also shown: ECS'92 (engineering-type, "bottom-up" model) and global aggregation of national CO_2 emission reduction costing studies of the CHALLENGE network (with Global 2100, a macroeconomic, "top-down" model).

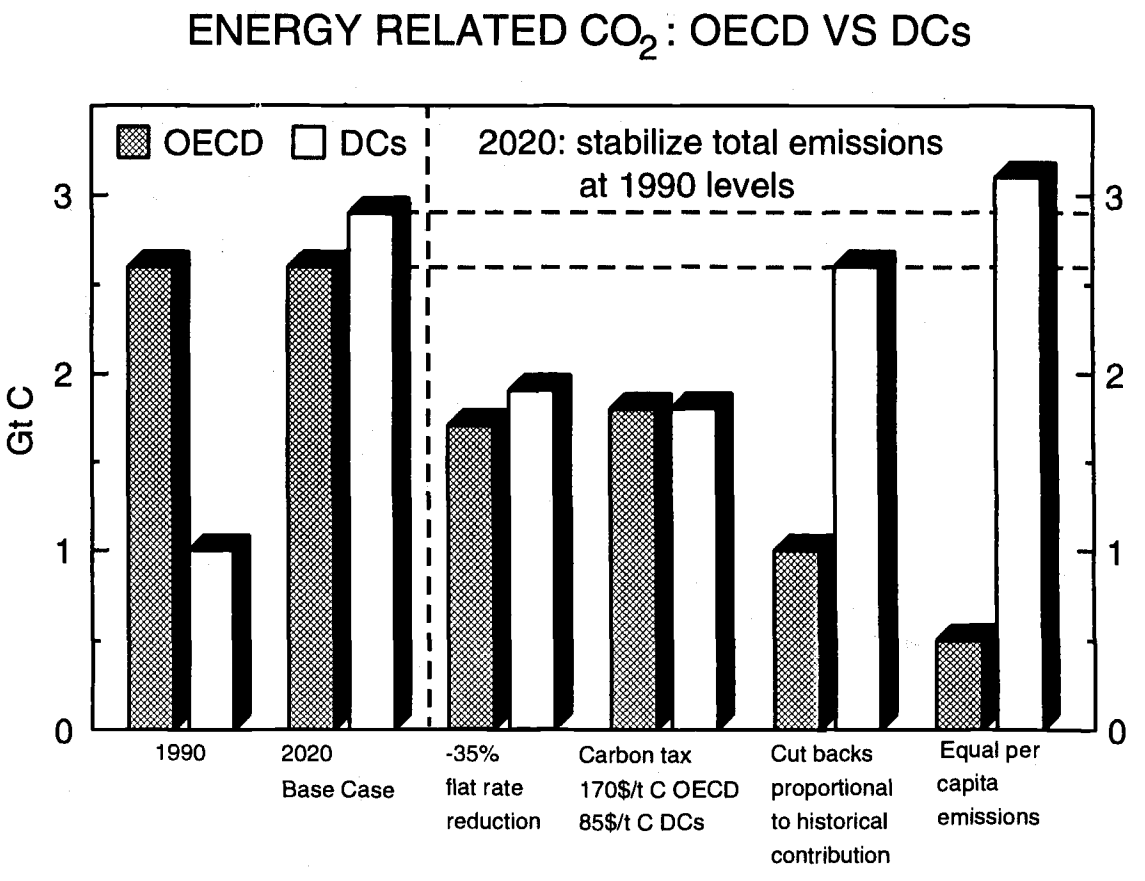

Figure 3. Energy-related CO_2 emissions 1990, base case (cost optimal solution without any emission constraints) by 2020 from the IIASA ECS'92 scenario (Nakićenović *et al.*, 1993), and possible stabilization scenarios, OECD versus developing countries (DCs), in Gt carbon. A number of burden sharing criteria are illustrated for a scenario of stabilizing global emissions by 2020 at 1990 levels. The resulting emission distribution of the introduction of a differentiated carbon tax of 170 and 85 $/ton carbon in the OECD and in DCs respectively is also shown.

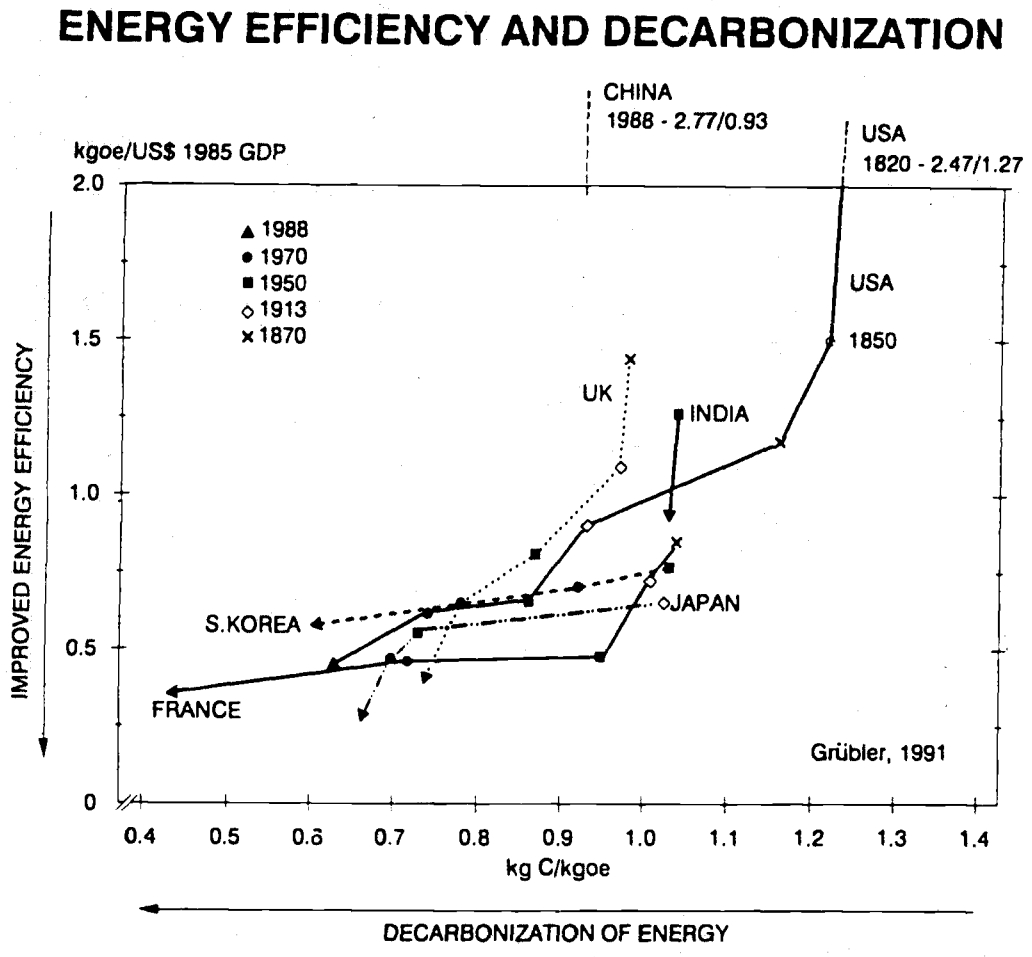

Figure 4. Historical trends in energy (kgoe per 1000 $ GDP) and carbon intensity (kg C per kgoe) of various countries. Improved energy efficiency (lowering the energy intensity) and interfuel substitution (lowering the carbon intensity of energy use) are two important options for lowering overall carbon emissions. The graph shows the diverse policy mix and strategies followed in different countries over the time horizon considered. France appears to follow a decarbonization strategy, whereas Japan mostly an efficiency improvement strategy. All countries shown achieved improvements in both domains. Source: Grübler, 1991.

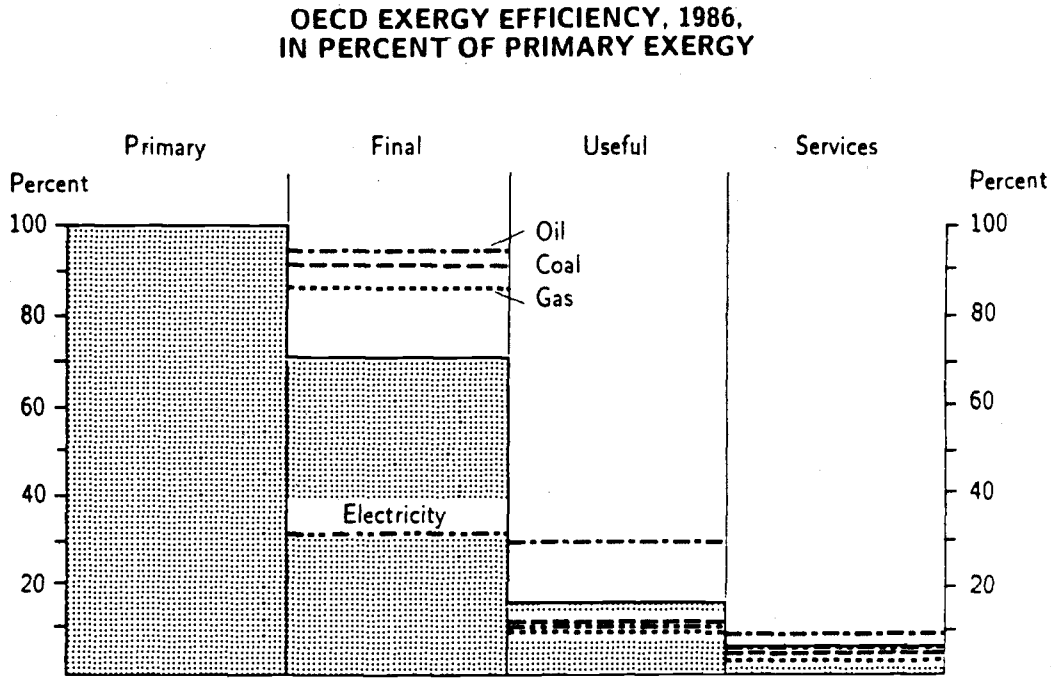

Figure 5. Exergy balances for the OECD countries in 1986 (in percent of primary exergy). A second-law analysis of the exergetic efficiency of the exergy (and energy) system in the OECD countries, shows that while the efficiency in the provision of final exergy is already quite high, efficiencies at the end-use side, and in particular in the provision of services are low. The overall exergetic efficiency of the OECD countries is estimated to amount only to a few percent. Figures for the former USSR and developing countries are even lower. This indicates a large theoretical potential for efficiency improvements of between a factor 20 to 100. Realization of this potential depends on the implementation of many technological options and organizational innovations. Their different tradeoffs, the cost and timing involved need detailed study. Source: Nakićenović *et al.*, 1990.

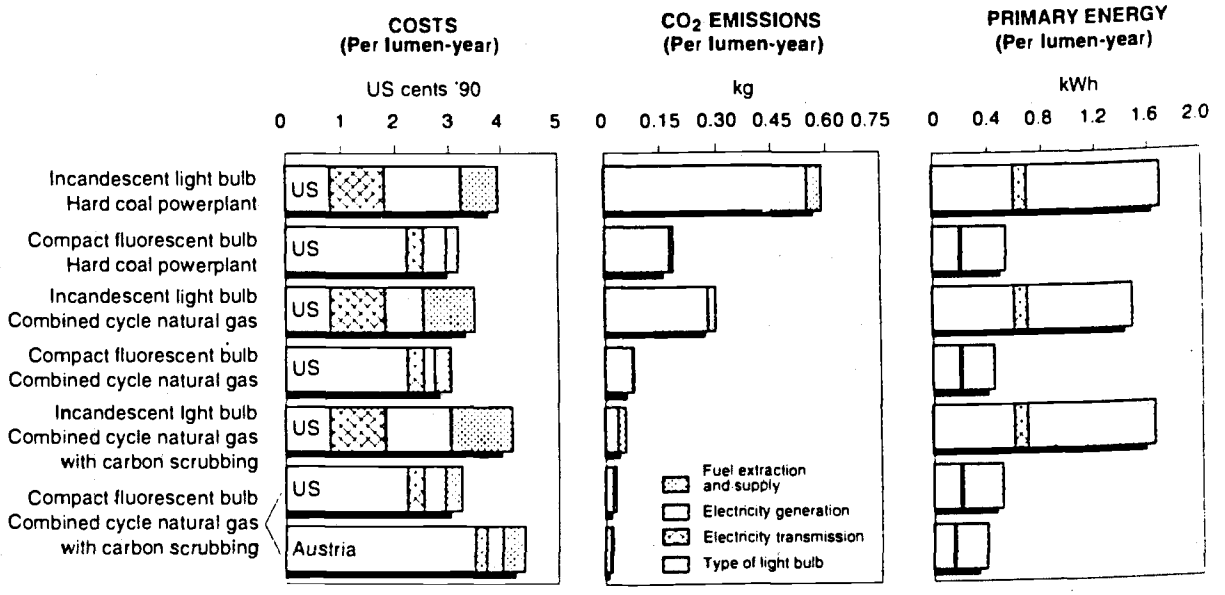

Figure 6. Primary energy, CO_2 emissions, and costs (US cents 1990) for alternative energy chains providing lighting (all units per lumen-year). Source: IIASA CO2DB.

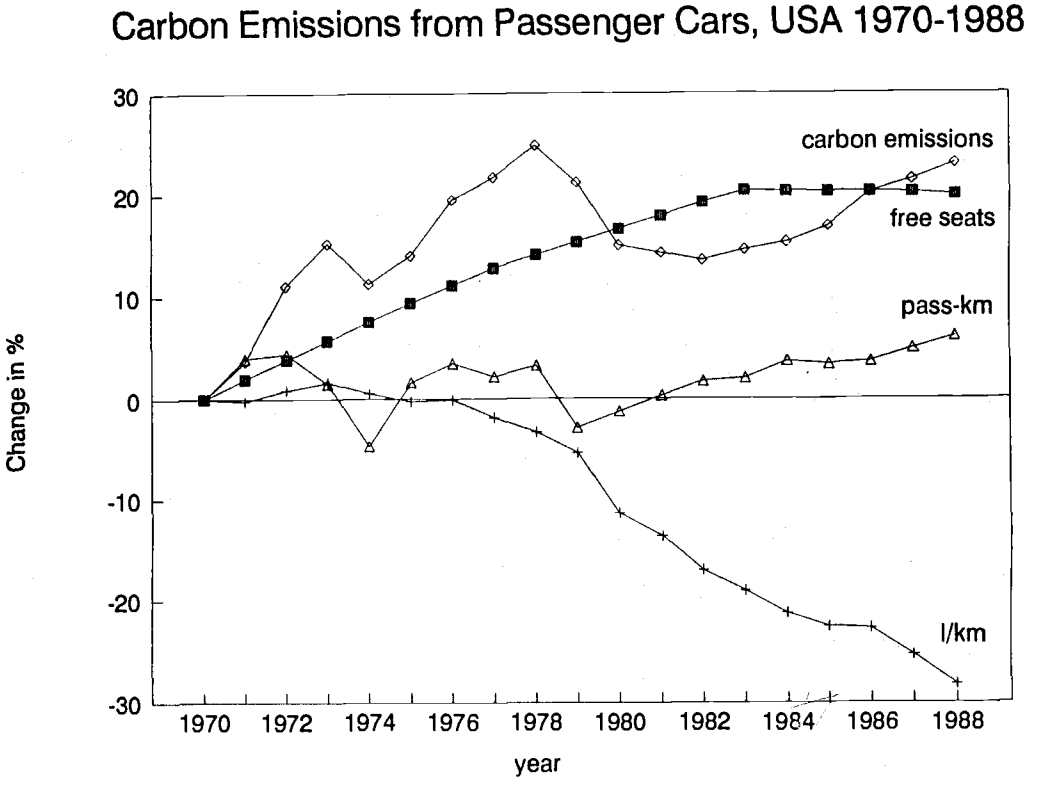

Figure 7. Evolution of factors contributing to carbon emissions from passenger cars in the United States (percentage change from 1970). Specific fuel consumption of cars improved by around 30 percent, passenger-km increased slightly, whereas average car occupancy deteriorated by some 20 percent. With less passengers per car, more vehicle-km are required to deliver a given volume of passenger-km. This change in the *usage efficiency* of private car utilization more than compensated the technological efficiency improvements. As a result, carbon emissions have increased by some 20 percent over 1970 levels. Data: courtesy of A. Schäfer, IIASA.

China's actions for global environment and development

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Environment and development now are the two major concerns facing the international community. Since the irrational exploitation and utilization of natural resources in the course of industrialization, it has resulted in global environmental pollution and ecological degradation, as well as real threat to the survival and development of mankind. It is, therefore, an urgent and formidable task for all countries in the world to protect the environment and maintain a sustainable development.

Solutions to two global issues of environmental protection and economic development need extensive and effective international cooperation. The UNCED offers a chance to international community to be able to discuss ways for solving environment and development problems. This will be a milestone in the world's history of environmental protection and development. Two important documents, i.e. The Rio Declaration and Agenda 21, were adopted and two Conventions, i.e. The Convention on Climate Change and The Convention on Biodiversity, were signed in UNCED. All actions of UNCED will lay a good foundation for enhancing international cooperation in the fields of environment and development.

Some opinions with regard to environment and development have been put forward by China.

- Economic development should be pursued in parallel with environmental protection.

Economic development provides a material guarantee for the protection and improvement of the global environment apart from the survival and progress of mankind. For most of developing countries, the first task is to develop the economy and then eliminate poverty, hence their reasonable and urgent requirements should be taken into consideration while the problem of global environment is tackled. At the same time, no country can afford to develop its economy in disregard of the pressure on environment. Therefore, it is imperative to work out a comprehensive development strategy which will ensure a better ecological cycle to obtain a balance between economic growth and environmental protection.

- Environmental protection is a common target and task of mankind as a whole

In view of historical fact and current situation, consumption of natural resources and discharge of pollutants, whether in terms of total volume or per capita quantity, are much bigger in developed countries than developing countries, thus the former should bear a greater responsibility. Moreover, developed nations possess strong economic strength and more sophisticated technologies for environmental protection, it is natural for them sharing a great obligation for its solution. As a result, developed countries should provide developing countries with new and additional funds and transfer technologies of environmental protection under concessional terms to help developing countries to be able to improve their own environment and to participate in the protection of global environment.

- Both near-term interests of each countries and long-term interests of whole world should be taken into consideration.

At present time, more addresses should be given priority to other urgent environmental problems facing developing countries, such as pollution, soil erosion, desertification, diminished vegetation, droughts and floods etc., while paying attention to the global environmental issues of climate change and biodiversity. It will be of significance for not only removing a serious threat to the environment and development of developing countries, but also contributing greatly to the protection of global environment and economic growth.

China always considers that China's environmental problems are part of global problems, and is keenly aware of its responsibility and role in the protection of the earth's eco-system. So that China has attached importance to and taken active part in the UN sponsored discussions concerning environment and development, and signed Rio Declaration and Agenda 21, and Conventions on Climate Change and Biodiversity in UNCED.

China has been paying much attention to environmental protection in the course of economic development and made environmental protection one of its basic state policies which to be incorporated into the strategic target of national economy and social development. Moreover, China has worked out, through practice, a series of policies and measures which suit to China's own conditions. Of which, three major principles are as follows:

- Putting prevention first.
- Holding those who cause pollution responsible for cleaning up.
- Strengthening management for environmental protection.

Unremitting efforts and hard work has brought remarkable results, over the past decade or more China has, in the course of reform and opening-up, maintained steady economic growth while averting a corresponding degradation of the environment, with even some local improvements. For example, atmospheric pollution in cities is mainly caused by the smoke produced in coal combustion. In 1991, total emission of waste gases (not including those from township and village enterprises) was 10,000 billion m^3, emission of soot (from stacks of coal-burning facilities) was 13 million tons, remaining at the same level as in 1990, of which 3.6 million tons were from coal-fired power plant.

After UNCED, China has proposed some responses, policies and measures, which should be adopted and implemented in the fields of China's environment and development, based on China's real practice.

- Pursuing the strategy of sustainable development.
- Controlling industrial pollution in terms of effective measures.
- Carrying out comprehensive controls of urban environment.
- Improving energy efficiency and shifting energy consumption composition.
- Diffusing eco-agriculture and planting trees to protect biodiversity.
- Enhancing environmental science and developing environment-related industries.
- Using economic means to protect environment.
- Strengthening education and heightening the awareness of the environment of the whole nation.
- Perfecting the legal system for better environmental management.
- Working out China's plan of action (Agenda 21 of China) in line with guidelines laid down in UNCED.

China's underlying belief is that effective environmental protection is not only an obligation to China and its posterity, but also an important contribution to the whole world.

Synergetic effects on hydrogen production from surplus hydroenergy for sustainable energy development in Nepal

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Statement of the problem

Nepal has no proven deposits of fossil fuels such as coal, lignite, natural gas and oil. However, the country is blessed with a vast hydropower potential which is, in fact, the single most important energy resource of the country.[1] The present national energy system of Nepal, however, relies almost entirely traditional biofuels which are supplemented with a small quantity of imported fossil fuels.[2] As energy demand is mainly confined to heat application, the share of electricity remains negligible in overall energy supply. The energy sector of Nepal thus exhibits a chronic structural imbalance between demand and supply.

The present energy consumption pattern in Nepal is clearly not sustainable and it has also threatened the ecological stability of the country. Nepal faces, on the one hand, massive deforestation in the bills with tragic consequences to the Himalayan ecosystem while, on the other hand, even limited reliance on imported fossil fuels has choked the process of economic growth by creating a balance of payments problem. Nepal thus experiences two types of energy 'crises' simultaneously. The 'firewood crisis' in the non-formal sector is well known. The 'oil crisis' in the formal sector is equally acute. This state of affairs demands a structural change in the energy consumption pattern at the earliest possible time.

The required structural change in the pattern of energy consumption in Nepal can be achieved only through a path of sustainable development. For this purpose, hydroelectricity is the only prominent renewable energy resource available in Nepal that can be harnessed on a large scale by mature technology. As such, it should assume a central role for the desired transformation of the energy consumption pattern in the country. In this context, the electricity sector in Nepal is at present characterised by considerable inefficiencies, notably by the occurrence of sizable surplus energy during the wet season. It is, therefore, proposed here to exploit this inherent problem of hydroelectric sector to create synergism which will help in achieving a sustainable change in the energy consumption pattern in Nepal.

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[1]The theoretical potential based on average flow is 83,280 MW(1). About 42,133 MW is likely to be economically feasible [2].

[2]Traditional energy contributed 94.7 percent and commercial energy 5.3 percent of total consumption in 1990/91 [3]. The major components of traditional or non-commercial energy are firewood (74.54%), agricultural residues (11.64%) and animal dung (8.3%).

Availability of surplus hydroenergy and potential for hydrogen production

The Integrated Nepal Power System (INPS) is the main power system in the country[3]. It has at present about 280 MW installed capacity, out of which almost 83 percent is provided by thermal (diesel) plants. Oil fired plants mostly serve as stand-by units and are operated only during peak demand periods for economic reasons. Thus the INPS is essentially a hydro system; at present there are altogether 14 hydro plants in this system with only one storage capacity for regulation.

The hydroenergy generating capacity of the INPS is highly seasonal in character due to the predominance of run-of-the-river schemes. The system produces more energy during the wet season (July to October), when the system load is much lower than in winter months. Hence surplus energy is bound to occur in a predominantly hydro generating system like INPS which is not properly backed by hydroelectric plants storage. The availability of surplus energy, however, varies greatly over time. In general, the availability of surplus energy will decrease if new projects are not added to the system. On the other hand, it will increase when a new project, particularly a run-if-the-river type of scheme commissioned. The magnitude of available surplus hydroenergy will thus vary from season to season and year to year. As a matter of fact, it will be available also in years when the system experiences acute power shortage and periodic load shedding has to be enforced.

There is at present no demand for surplus hydroenergy in residential, commercial, industrial or transport applications due to the unassured nature of its supply. It also has a restricted export market due to the same reason. Hence, a sizable quantity of hydroenergy is simply wasted in the system for year to year.

The magnitude of surplus energy available in INPS in the future will be considerably affected by the nature of future hydroelectric development projects. In this context, the size of the internal power market cannot alone justify the construction of large storage projects in Nepal. However several large-scale, multi-purpose storage projects with installed capacities in the order of thousands of megawatts are also proposed in Nepal, primarily for energy export to neighbouring countries. It is yet uncertain when these projects will be realised. Growing environmental concerns at national, regional and global levels are creating considerable opposition for the construction of large storage projects. The geological and seismic features of the Himalayan region have raised additional uncertainties in this respect.

The assessment of surplus hydroenergy available in INPS for the next 15 years (1993-2007) based on the existing plan for power development in Nepal is presented in Table 1. All hydroelectric projects proposed for development upto the year 2000/01 are run-of-the-river projects; therefore, with the commissioning of each new plant the seasonal surplus will be available for a longer duration of time reaching a year-round surplus between 2000/01 to 2002/03. The availability of seasonal surplus energy will continue to occur beyond 2006/07 even without the additon of any other new project in the system.

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[3]Besides the integrated grid, there are 30 isolated local systems each one served by a small hydro plant in the remote regions. Further, hundreds of micro-hydel units are operated by private entrepreneurs in Nepal.

Table 1. Surplus/deficit of hydro-energy in 'Integrated Nepal Power System' (Gwh)
(1992/93 - 2006/07

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total Annual Surplus/Deficit
1992/93	19.41	20.78	34.57	35.94	23.34	-8.80	-18.24	-15.90	-15.89	5.94	37.27	22.36	140.72
1993/94	23.82	24.64	38.80	40.66	27.11	-5.78	-15.43	-14.36	-14.06	7.10	38.30	24.52	175.32
1994/95	14.22	14.34	29.50	30.96	16.51	-16.98	-16.07	-24.26	-23.66	-2.50	28.40	14.42	64.88
1995/96	4.52	4.04	19.40	21.16	5.91	-28.22	-36.93	-34.16	-33.36	-12.10	18.50	4.32	-66.92
1996/97	-7.38	-8.56	7.30	9.16	-7.09	-41.91	-50.07	-46.46	-45.16	-24.00	6.40	-8.18	-216.02
1997/98	54.22	52.24	30.90	35.16	49.11	-4.01	-28.17	-32.84	-28.46	4.50	56.20	49.42	238.20
1988/99	40.92	38.04	17.50	21.66	34.51	-19.58	-42.97	-46.46	-41.76	-8.80	42.60	35.42	71.08
1999/2000	27.32	23.54	3.70	7.86	19.51	-35.48	-58.18	-60.46	-55.36	-22.40	28.60	21.12	-100.23
2000/01	177.66	175.53	153.84	158.00	168.25	108.52	73.34	53.71	69.71	120.97	177.20	170.66	1607.38
2001/02	159.46	156.13	135.84	139.60	148.25	87.3	53.04	35.01	51.41	102.77	168.60	151.56	1388.78
2002/03	138.16	133.43	113.94	118.00	124.95	62.6	29.34	13.11	30.26	81.57	136.70	129.16	111.23
2003/04	115.06	108.73	90.64	94.60	99.65	35.71	3.64	-10.69	7.21	58.57	113.10	104.96	821.58
2004/05	215.00	208.97	190.28	194.24	185.91	65.98	-14.62	-34.99	-10.51	73.48	184.24	203.60	1461.58
2005/06	185.60	177.67	160.58	164.44	153.71	331.78	-47.32	-65.29	-39.81	44.28	154.14	172.80	1092.58
2006/07	154.70	144.67	129.38	133.24	119.81	-4.12	-81.70	-96.99	-69.61	13.08	131.54	148.50	622.50

Source: Asian and Pacific Centre for Transfer for Technology [4].

The hydrogen production potential of surplus hydroenergy available in INPS is calculated in Table 2 assuming two different electrolyzers efficiencies. The maximum production potential (about 4 to 5 million GJ (gigajoules) occurs in the year 2000/01. Needless to say, the hydrogen production potential also varies from year to year, basically reflecting the pattern of surplus hydroenergy availability in INPS.

Table 2. Hydrogen production potential of surplus hydro energy available in INPS

Year	Annual Surplus Energy (GWh)	Hydrogen Production Potential			
		Volume (10^6 Nm^3/annum)		Energy [3/] (10^3 GJ/annum)	
		Min.[1/]	Max.[2/]	Min.[1/]	Max.[2/]
1992/93	199.61	47.37	60.89	492.63	633.30
1993/94	224.95	53.38	68.62	555.17	713.69
1994/95	148.35	35.20	45.26	366.12	470.67
1995/96	77.85	18.47	23.75	192.13	246.99
1996/97	22.86	5.42	6.97	56.42	72.53
1997/98	331.75	78.73	101.21	818.75	1052.53
1998/99	230.65	54.73	70.36	569.24	731.78
1999/2000	131.65	31.24	40.16	324.91	417.68
2000/01	1607.38	381.44	490.35	3966.96	5099.68
2001/02	1388.78	329.56	423.67	3427.46	4406.14
2002/03	1111.23	263.70	339.00	2742.48	3525.56
2003/04	831.87	197.41	253.77	2053.03	2639.25
2004/05	1521.70	301.11	464.22	3755.50	4827.85
2005/06	1245.00	295.44	379.80	3072.62	3949.97
2006/07	974.92	231.35	297.41	2406.07	3093.10

Notes: 1-/ Minimum 70% efficiency
2_/ Maximum 90% efficiency
3_/ Lower heating value for hydrogen = 10.4 x 10^3 KJ/m^3

Source: Asian and Pacific Centre for Transfer of Technology [4].

Advantages of the hydrogen storage option

The storage of surplus hydroenergy is conceived here in form of hydrogen through the electrolysis of water. The electrolysis process is based on the electro-chemical decomposition of water into its components hydrogen and oxygen in a ratio of 2 : 1

respectively, by passing direct current through a dilute aqueous solution of alkali due to the low conductivity of water. The equation is as follows:

$$2H_2O + Energy \rightarrow 2H_2 + O_2$$

There are many advantages of converting surplus electricity into hydrogen in the Nepalese context which are elaborated at some length below.

Electrolysis as a technology

Electrolysis has been used in commercial operations from the beginning of the century and it is a time tested technology. It is conceptually simple and reliable and represents a mature technology. It has long useful life and is easy to operate owing to the simplicity of the process and hence can easily be adapted to Nepalese context.

Hydrogen as a fuel

Hydrogen has excellent properties as a fuel and can compete with conventional fossil fuel such as petrol, diesel, natural gas, etc. It can be used as an automotive fuel and also as a source of heat in industrial, residential as well as commercial applications.

Electrolysis as a source of hydrogen

Electrolysis of water yields pure hydrogen (99.9 + 0.1% by volume). In fact, it is the only process which produces hydrogen of such purity. In other processes using hydrocarbon feedstocks, the cost of hydrogen purification comprises the major part of the operating cost. The pure hydrogen fuel obtained from electrolysis has high energy content and can be used directly without further purification in all end-uses.

Hydrogren storage

Hydrogen has a long storage cycle and it can be stored over a long period of time. Further, hydrogen can be stored in form of gas (GH_2), liquid (LH_2) and metallic hydrides (MH_2). Each of these storage options has its own advantages and disadvantages, but they still offer wide range of storage options.

Electrolyzers efficiency

Industrial electrolyzers operated earlier at efficiencies of 60 to 70 percent. But advanced electrolyzers have achieved 90 percent efficiency. Further R & D is underway to improve the efficiency of this process to 95 percent or more [5].

Electrolyzers capacity

Electrolysis plants do not have marked scale of economies i.e., the production of hydrogen is not highly sensitive to the plant capacity of scale of operation as in other chemical processes. Hence, electrolysis can abe operated at wide capacity ranges without high diseconomies of scale. In fact, industrial electrolyzers range in size from 500 standard cubic feet of hydrogen production per day consuming 3 kW of electricity to more than 40 million standard cubic feet of hydrogen per day consuming 240,000 kW [6]. The electrolysis plant achieves its rated capacity rather quickly after its start-up. Hence, electrolyzers can be switched on or off according to the energy supply situation in INPS. Thus electrolyzers can be ideally dovetailed with the electrical system.

Increasing economic efficiency of hydrogen production

The electrolysis process produces two co-products, hydrogen and oxygen. The production of oxygen is half the quality of hydrogen and it is 99.5 + 0.1 percent by volume pure. As the two gases are produced simultaneously, it is reasonable to refer the power consumption for both gases (H_2 + O_2). Generally, pure oxygen is vented to the atmosphere due to the lack of captive demand for this product in large scale installations. Thus the lack of oxygen credit in almost all cases increases the overall generation cost of hydrogen. Hence the feasibility of electrolysis upon the utilization of co-product oxygen. Heavy water or deuterium, which is used as a moderator in nuclear reactors, can also be produced as a by product of electrolysis.

The storage of surplus electricity in form of hydrogen thus appears an ideal solution for a country like Nepal.

Synergetic effects

The production of hydrogen from the available surplus hydroelectricity in INPS offers a unique opportunity for synergism which can produce wide ranging impacts on the energy sector of Nepal. As stated earlier, the electricity sector in Nepal is characterized by surplus or waste energy and hence it is not very efficient as a separate entity. On the other hand, the production of hydrogen by the electrolysis process, if envisaged as a separate activity, will certainly not be economic due to the prevailing high electricity tariff in Nepal. But if the surplus energy available in INPS is utilized for hydrogen production or if hydrogen is conceived as a co-product of electricity generation, this combined and coordinated measure will produce entirely different and more preferable result due to synergism.

Synergism has many effects which are summarized in figure 1. These can be divided into two groups, i.e., effects on the energy sector and the non-energy sector. We shall elaborate these effects at some length here. While some synergetic effects are minor ones, others can substantially tilt the decision in favour of hydrogen. First the use of hydrogen as a co-product of electricity sector offers a wide range of flexibility in the fixation of the factor cost of the most important input (electricity) as well as the capital costs (depreciation) of electrolyzers. As a rule, hydrogen generated from electricity will be more expensive than the electricity that produced it. But in this case the production of hydrogen will utilise the surplus energy available in the system which is otherwise wasted. The cost of the electricity input is, therefore, bound to be flexible in this context. Similarly, the depreciation of the electrolysis plant is not solely determined by the life span of the assets due to physical deterioration but more by government regulations (incentive for quick recovery of fixed capital investment) as well as company policies. Hence, the synergetic effect could enable hydrogen production at a much lower cost than under normal circumstances and thereby make economics of hydrogen much more attractive for fossil fuel substitution.

The economic viability of hydrogen generated from surplus electricity to substitute conventional fuels depends upon a host of socio-economic and technical factors which are not known at this stage. Nevertheless, some preliminary observations are forwarded here basically to illustrate the synergetic effects of electricity-hydrogen co-production on the cost of hydrogen.

The production cost of hydrogen is determined by three items : a) cost of electricity; b) depreciation of electrolysis plant and c) other costs. In fact, the first two items generally comprise as much as 90 percent or more in the total cost of hydrogen

production. Both these cost items, which are generally considered exogenous variables under the separate provisions for hydroelectric schemes and hydrogen plants, become quite flexible when these two schemes are combined together as a single project as proposed earlier. On the one hand, the tariff of surplus electricity is highly flexible within two extreme limits; the upper one set by the existing tariff for industrial application and the lower one being zero. On the other hand, the useful life of the electrolysis plant is very much longer than the 10 to 12 years conventionally adopted for calculating depreciation (many electrolysis plants are operating normally even after 25 to 30 years of service all over the world). Therefore, a lower rate of depreciation than adopted in conventional practice can be enforced. It may be possible to promulgate special legislation, if required, for this purpose. Thus, these two items, namely the tariff of surplus electricity and the rate of depreciation of the electrolysis plant when combined together will offer wide leverage for determining the production cost of hydrogen. Hence, in all probability hydrogen can be a real, economic alternative to substitute conventional fuels in Nepal due to these synergetic effects.

We shall now briefly examine the synergetic effects of electricity and hydrogen co-production on the electricity sector. Needless to say, the electricity sector will be the first major beneficiary of the synergetic effects. The hydrogen co-production from the available surplus energy in INPS will save waste energy; it is always cheaper to save energy than to generate it. In fact, hydrogen co-production with electricity will not only conserve waste energy but also increase the overall load factor and the economic efficiency of the system. At the same time, it will generate additional revenue to the electricity authority, even if the surplus energy is valued at less than the prevailing price of electricity in Nepal. This additional revenue will help improve the financial health and solvency of electricity undertakings. The synergetic effect could also make small hydro development schemes economically more attractive by producing both electricity and hydrogen for decentralized applications.

Above all, the issue of economic efficiency is of vital importance. Economic growth is an essential condition for development and the hydroelectric system—the most important energy supply system in the country must be highly efficient in order to support economic growth in the country. The present state of affairs, however, means that the electricity sector is not capable even to support its own growth. This is the paradox of Nepal's electricity sector. Needless to say, social costs of buttressing economically inefficient technology are very high and cannot be sustained for ever. While the imperative to develop hydroelectricity—the most important energy resource in the country is essentially recognised in all quarters, the actual development of this sector has been hampered by many factors, both internal and external, among which the present economic performance of this sector is not of least importance. As such, there is genuine apprehension that the electricity sector will remain inefficient as long as the present trends in generation and consumption continue to persist. Hence, it is essential to intervene with measures to modify this pattern of generation and consumption. Hydrogen could serve as an ideal mechanism for this purpose.

The energy sector as a whole will also substantially benefit from these synergetic effects. The co-production of hydrogen will supply another type of storable fuel which can find much wider applications than electricity itself. In other words, the synergetic effects will enable the production of a new type of storable energy source (hydrogen) from the surplus or waste of another source (electricity) so that instead of a single, traditional source we have at hand two types of energy sources and are highly

complementary to each other. Hydrogen is a versatile energy source which can be used in automotive, domestic, industrial and commercial applications. As a multi-purpose fuel, hydrogen can serve as the key component for the required energy mix in Nepal and can potentially substitute all other types of traditional and fossil fuels in use in Nepal. Viewed from this perspective, hydrogen appears as a panacea for relieving both kinds of energy 'crisis' in Nepal, namely, 'firewood crisis' in non-formal sector as well as 'fossil fuel crisis' in the formal sector. The hydrogen-electricity energy mix can thus substantially modify existing patterns of energy production, distribution and consumption in Nepal and shift them towards the path of sustainable development.

Anotherf effect of synergism is its potential to substitute imported fossil fuels. These are used mainly in a) transportation (high speed diesel, petrol, aviation turbo fuel, etc.), b) households (kerosene for lighting and cooking), c) industry (light diesel oil, furnace oil, coal, etc for steam generation) and d) agriculture (diesel for pumpsets and tractors). The transport sector consumes the bulk of imported oil. Oil consumption in Nepal is mainly represented by two middle distillates—high speed diesel and kerosene which can technically be substituted by hydrogen in all specified end-uses. Hence, hydrogen has potential to substitute the bulk of imported fossil fuels in Nepal.

The scope of traditional biofuel substitution used for rural domestic cooking purpose is another important aspect of synergism. Again, this substitution is technically feasible as evidenced by the development of hydrogen cookers today (7, 8). In fact, the catalytic cookers are the practical answer to this problem. Hence, hydrogen can potentially replace biofuels even though there are serious social as well as techno-economic barriers for this purpose.

A major issue for sustainable development is to reduce the absolute quantity of energy required for development. In other words, the imperative at this stage of development is to achieve the same level of welfare and comfort at a much lower rate of energy consumption than today. This statement may appear paradoxical, but is true. The present per capital energy consumption in Nepal (about 14 GJ or 326 Kgoe), though extremely low by international standards, cannot be maintained at this level of consumption let alone be increased proportionately with the population growth in the country. The biofuels consumed today have extremely low utilization effeciencies particularly in domestic cooking operations, which is apparent from the large volume of biofuel consumption in Nepal. This is a avoidable wastage of resources.

Under the given circumstances, it is difficult to imagine how the present pattern of biofuel consumption can continue into the next century without an ecological catastrophe. Nevertheless, the response to this dilemma has been lukewarm. Ecological disintegration, however, can be averted only be averted by a shift in domestic energy consumption towards sources which have higher energy densities as well as greater end-use efficiencies. Hydrogen fulfils these criteria and can substitute most biofuels in cooking operations using much less energy.

The experimental performance of hydrogen technologies have been quite encouraging in many areas. For example, hydrogen as a transport fuel has reportedly performed such better both in terms of brake thermal efficiency and kilometres travelled per unit of fuel consumed than the conventional petrol engine (1, 5, 9, 10). Hydrogen lighting as electricity, gas or by condoluminescence is expected to be far superior and more efficient than kerosene lighting. Similarly, hydrogen consuming gas stoves (catalytic cookers) could have an efficiency of 100 percent [5] as against about 50 percent for pressurised kerosene stoves and 10 percent for traditional domestic

cooking stoves. Thus hydrogen is expected to fulfil the same task at a much lower level of energy consumption than traditional biofuels. Hence, the synergetic effects of electricity-hydrogen co-production will support sustainable development by reducing the absolute quantity of energy required.

The synergetic effects will also contribute to the satisfaction of basic needs. Energy consumption is not an end in itself. It is only a means to provide services to various human economic activities. Since each human activity is directed towards the satisfaction of a particular need, it is pertinent to ask who consumes the energy and for what purpose. These questions are particularly important in the Nepalese context where the present energy consumption pattern is highly skewed towards affluent sections of society. On the other hand, the basic needs of poor households, which represent the bulk of the population in the country, are largely ignored. The large scale deforestation and the impending ecological crisis cannot however be checked until and unless the energy problems of the poor, particularly relating to cooking fuel, are not properly addressed and solved. The hydrogen alternative offers a solution by providing both automotive and domestic fuel which are directly related to basic need activities.

We now turn to non-energy effects of synergism in terms of environmental protection, the development of national scientific and technological (S & T) capability, and national self-reliance in energy supply. All these issues are intricately related to sustainable development.

In a nutshell, the rapid growth of population, mass poverty and low economic growth are the main factors responsible for environmental degradation in Nepal. In addition, the large-scale adoption of western technologies and lifestyles in Nepal have further aggravated environment problems. Moreover, the political and economic system has so far equated 'economic growth' with development. Growth however does not imply development and the obsession with growth has led to further environmental problems. In this context, the present patterns of production, distribution and consumption of.energy are directly responsible for many 'external' impacts on the environment. On the other hand, hydrogen is a clean energy. The production of hydrogen via the electrolysis of water has no adverse environmental impacts. The distribution of hydrogen in form of gas, liquid or hydrides also does not pollute the environment. Hence, the synergetic effects of hydrogen co-production are environmentally benign.

The hydrogen option has important implications on national S & T development. Hydrogen is more hazardous than other conventional fuels. Hence the production, storage, distribution and use of hydrogen requires relatively sophisticated technology. The successful application of hydrogen in Nepal is possible only if the technologies currently available can be transferred and assimilated in the country. As a matter of fact, mere access to existing technologies may not be enough; it will be essential to adapt these technologies to the local context.

Finally, self-reliance in energy supply is a vital issue of national importance which cannot be expressed merely in monetary or economic terms. Nepal's vulnerability to Nepal with regard to reliabile and secure oil supply was exposed by the trade impasse between Nepal and India in 1988/89. The profound economic, political and psychological effects and hardship experienced by Nepal due to the dependence on oil supply need no elaboration here. The oil import burden is increasing the foreign exchange crunch and the chronic adverse balance of payments situation of the country. The increasing volume of foreign debt has not only made debt servicing

difficult but has also enabled external institutions to intervene in Nepal's internal policy matters. Under these circumstances, the synergetic effects of electricity and hydrogen co-production could considerably reduce this vulnerability by offering a solution, however partial, to attain national self-reliance in energy supply.

In conclusion, the synergetic effects of electricity hydrogen co-production offers Nepal a unique option for an entirely different soft development path towards greater self-reliance and sustainable development.

Applying hydrogen technology in Nepal

The application of hydrogen as an energy alternative for day to day use is still considered rather exotic despite significant use in industry. Besides cost safety considerations in storage and handling seem to be the other main restriction for using hydrogen as a fuel for automotive and domestic purposes. Storage and handling problems of hydrogen have been satisfactorily solved for industrial application. However, it appears difficult to enforce the same rigid specifications in design and safety regulations in operation and maintenance of machinery and appliances earmarked for individual consumers or households. Nevertheless, the technologies required for safe storage and handling of hydrogen on a small-scale have already been developed and marketed, even though they are still very expensive for common use [11].

The application of hydrogen in Nepal would require a judiciously identification of the areas in which the application of hydrogen can be economically competitive with other conventional fuels under the given conditions of demand and supply and then supply appropriate technologies for these applications. These issues will be governed by three important considerations. First, hydrogen as an energy alternative has to provide a viable solution for the core energy problems of Nepal. Second, the appropriateness of hydrogen as an energy source in various end-uses will depend upon its properties as a fuel, including ease in storage. Finally, the selection of hydrogen end-uses in Nepal will be considerably influenced by the current trends in international R & D in hydrogen related technologies.

In this context, Nepal's specific problems may necessitate the fashioning of new technologies by an original combination of existing components for specified uses. A certain degree of technological capability within the country is essential for this purpose. While all these issues are important for the successful application of hydrogen as an energy alternative in Nepal, the present limitations in Nepal's S & T capability presents considerable problems for appropriate technology supply. The implication is that technology supply will depend considerably upon the goodwill and co-operation of industrialised countries as well as international agencies.

Under these circumstances, a major concern is the likely evolution of hydrogen end-uses which could either help meet the basic needs of the masses or encourage the consumption of imported luxury goods by local elites. This issue is very sensitive because the use of hydrogen is advocated in the Nepalese context to solve the crises of dual society which is marked by glaring inequities. As Mentioned earlier, on the one hand, hydrogen has been offered as a potential solution for the 'firewood crisis' where it would provide cooking energy (together with lighting) to rural areas. But in reality, hydrogen as a commercial fuel is likely to encounter many socio-economic problems in cooking applications. On the other hand, hydrogen is expected to alleviate the 'oil crisis' by substituting oil in the modern sector. However, this solution will vary,

depending upon whether hydrogen would replace oil in transportation vehicles (buses and trucks) or in passenger cars.

While the techno-economic feasibility of hydrogen technology can be established in some judiciously selected areas of application, its social acceptance remains an enigma. Hence, hydrogen should not be simply viewed as a technocratic solution; a holistic approach should be taken for its promotion. The technological intervention with hydrogen as a new energy alternative into existing production systems, both urban and rural, will necessarily have many social engineering consequences which need to be properly studied and analysed.

While the government and outside agencies can create awareness and the opportunity for social change through a technological intervention, the success of that particular social change will depend upon the attitudes and motivations of that community towards it. By and large, these attitudes and motivations are governed by their own 'felt needs' and perceptions of social goals. In this respect, the application of hydrogen technologies is likely to have very much different social implications in different end-uses. While the automotive use of hydrogen in mass transport vehicles not likely to encounter any serious social resistance, cooking with hydrogen can be an entirely different proposition. Cooking is deeply rooted in the cultural tradition of a society nad different ethnic and cultural groups in the country have considerable diversity in food habits. Further, the capacity of the cooker as well as cooking pots have to be adopted according to the family size. As the hydrogen cooker is essentially a gas cooker, it is expected to overcome these problems with appropriate modifications in technical design. Nevertheless, some social objections may arise due to the change in the flavour of cooked food (e.g., in comparison to traditional cooking over open fire) or due to the invisibility of hydrogen flame in the case of catalytic cookers.

Comparative costs: a case study

The comparative cost analysis of hydrogen with fossil fuels for automotive use involves three different issues. First, the competitiveness of hydrogen as a fuel with respect to petrol and diesel in Nepal will depend relative economic costs. Second, the use of fossil fuels causes environmental damage as against the clean, renewable hydrogen energy. The damage due to fossil fuel use should be incorporated into the comparative cost analysis. Finally, hydrogen as a fuel can be used in existing internal combustion OC engines with minor modifications. However, the relative efficiencies of petrol, diesel and hydrogen are different for operation in these engines and should also be taken into account for the comparative cost analysis. Hence, a recently developed conceptual framework will be adopted here which defines a societal or effective cost to cover production cost, environmental cost and utilisation efficiency [5]. The societal or effective cost is the total cost that the society has to pay for use of a particular fuel and it is given by the following equation :

$$S_s = [C_s + E_s \frac{p_s}{p_f}] \frac{n_f}{n_s}$$

where

S_s ... societal cost of synthetic fuel

S_s ... production cost of synthetic fuel

E_s ... environmental cost of synthetic fuel
P_f ... pollution factor of fossil fuel
P_s ... pollution factor of synthetic fuel
n_f ... utilisation efficiency of fossil fuel
n_s ... utilisation efficiency of synthetic fuel

Production/economic costs

The comparative economic costs of GH_2, LH_2, petrol and diesel are presented in Figure 2. The economic costs of imported petrol (US $7.11/GJ) and diesel (US $6.75/GJ) in landlocked Nepal are much higher than in the international market due to additional handling, storage and transportation costs. Even though the economic costs of imported petrol and diesel are in the same range, there is a big difference in their retail prices in the Katmandu market; petrol is sold at US $21.14/GJ as a luxury item, while the price of diesel is fixed at US $7.14/GJ as an essential commodity for mass consumption. On the other hand, it is rather difficult to generalise the production cost of electrolytic hydrogen due to many factors[4]. For the sake of illustration, the production cost estimates of hydrogen based on the Commission of European Communities research programme [12, 13] have been adopted here in Figure 3. The production cost of GH_2 varies between US $4.99 to 23.34/GJ in the lowest and highest alternatives respectively. The cost for LH_2 is about 25 percent higher than in case of GH_2 owing to the additional cost of liquefaction.

At first glance, both GH_2 and LH_2 options do not appear economically competitive with conventional petrol and diesel fuels. However, the availability of surplus hydroelectricity in the grid (which has zero economic cost) tilts the balance towards hydrogen. The production cost of off-peak GH_2 (without electricity cost) is quite competitive with economic costs of imported petrol and diesel alternatives in Nepal.

Further reduction in the production cost of GH_2 indicated above appears possible by decreasing capital costs. A recent study conducted on the production of electrolytic hydrogen from off-peak power indicates that medium-efficiency, low-cost electrolyzers may be better suited for this purpose than high-efficiency, high-cost electrolyzers [14]. In addition, an appropriate depreciation policy as noted earlier above could further help reduce the capital cost. Hence, GH_2 can be realistically considered economically competitive with imported petrol and diesel in Nepal.

Environmental costs

The major environmental problems directly associated with the consumption of fossil fuels are air pollution, acid rain and the greenhouse effect with its consequent impacts. hese adverse impacts of fossil fuel consumption have been known for some time, but attempts have been made to value them only recently as a result of growing environmental concern throughout the world. Detailed estimates of the damage caused

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[4]The major factors which determine the production cost are :
(a) scale of operation (large/medium/small scale);
(b) nature of operation (continuous/off-peak);
(c) types of electrolyzers used (conventional/advanced alkaline/solid polymer/high temperature);
(d) cost of electricity for hydrogen production (industrial/off-peak tariff);
(e) type of hydro plant (old/new); etc.

by fossil fuels on various elements of biosphere are now available and the total cost adds to US $10.62/GJ (5).

The estimated environmental damage at US $10.62/GJ is indeed much higher than the economic costs of imported petrol (US $7.11/GJ) and diesel (US $6.75/GJ) in Nepal. This is the price society has to pay in addition to the economic cost for the use of fossil fuels. If we assume that current taxes on fossil fuels are environmental taxes, then petrol is taxed (US $14.03/GJ) more than justified by the environmental damage it causes whereas diesel remains virtually untaxed (US $0.39/GJ) without proper compensation for the damage caused by its use. This discriminatory practice of taxing petrol and diesel at different rates, however, is not compatible from the environmental viewpoint even though social considerations may dictate otherwise.

Utilisation efficiencies

The relative end-use efficiencies of hydrogen, petrol and diesel in automotive use is the next import issue here. The end-use efficiency of hydrogen in road transport vehicles, however, differ according to its form (GH_2, LH_2 and M_2) as well as its mode of operation (IC engines or fuel cells). In general, the relative utilisation efficiency of hydrogen is superior to fossil fuels in conventional IC engines. The performance of experimental hydrogen vehicles and engines have demonstrated much higher efficiency in compared to petrol engines [9]. On average, a value of 22 percent better overall efficiency has been suggested [15]. While the average efficiency of the conventional IC engine is considered about 25 percent for petrol, 30 percent for GH_2 and 33 percent for LH_2, it increased dramatically to 70 percent for GH_2 with fuel cells [5].

Societal costs

The societal costs of petrol, diesel and hydrogen (GH_2 and LH_2) are presented in Figure 4. For application in IC engines, GH_2 has the lowest societal cost followed by LH_2, diesel and petrol. But among all alternatives under consideration, GH_2 with fuel cells has the least societal cost. It is cheaper than IC engines in all cases. In fact, GH_2 in IC engine or four times cheaper than petrol.

The present Government petroleum pricing policy has significant implications for substituting petrol and diesel with hydrogen in Nepal. As the retail price of petrol is artificially boosted through taxes, hydrogen is competitive with petrol and its production from surplus hydroelectricity would yield substantial revenue to the electricity authority even if the surplus energy is valued much below the prevailing industrial tariff. On the other hand, the substitution of diesel with hydrogen—the preferred alternative is only possible in an IC engine if the surplus energy is made available free of cost. The simultaneous substitution of both diesel and petrol with hydrogen appears to offer scope for cross subsidising the former with the latter. However, since diesel consumption is six times larger than petrol in Nepal in 1990/91, this measure has only a limited validity. Hence, a revision of government policy on diesel appears to be essential for its substitution with hydrogen in Nepal. The practical development of fuel cells would enable the substitution of diesel with hydrogen even under the existing retail price structure.

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Climate Change: the challenge facing the ESI of LDCs

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Background

The year 1992 has been strongly marked by the UNCED Conference. After more than two years of preparation, high level representatives from 153 countries (many of them chief of State) met in Rio to sign two treaties (Climate Change and Biodiversity) and to agree on a set of green guidelines for global action (Agenda 21). Some consider these results a substantial achievement (von Weizsacker, 1992) while others are far less enthusiastic (Khor, 1992). The main divide between these two opinions is the practical result of the conference, since there is a general agreement that the conference was a success as far as improving public awareness of the environmental challenges facing industrial societies.

Both the refusal by the Americans to sign the biodiversity treaty and their unwillingness to accept a specific timetable for the stabilisation of greenhouse gases are pointed out as clear indications that global environmental problems would not be easily solved. The United States is the largest consumer of world natural resources and it concentrates the financial resources and the technological capabilities that are indispensable to deal with either local or global environmental problems. It is hardly imaginable that environmental policies can possibly have any substantial global effect if the United States remains untouched by these policies. The scepticism that emerged among developing and industrial countries about the actual outcome of the Rio Conference is therefore perfectly understandable. President Bush's statement that the 'American life style was not up for negotiation' (Khor, 1992) has done nothing but confirmed this scepticism.

Among developing countries policymakers, this scepticism was to some extent reinforced by studies on global warming carried out in industrialised countries. The strong emphasis put on the contribution of developing countries, anthropogenic activities (particularly forestry, rice fields, feedstock and their likely future energy consumption) to greenhouse gas emissions has been perceived as designed to minimise the role of industrial countries' CO_2 emissions, resulting from their fossil fuel consumption, on climate change (Aganval/Narain, 1991). It is worth remarking that despite this scepticism, developing countries supported the convention on climate change. The agenda for both developing and industrial countries was settled and now one must start thinking about its implementation.

The Convention clearly focuses on the sources for action in industrial countries (Energy Economist, 1992). However, developing countries should not remain passive. Indeed, poverty is the world main source of environmental damage. Developing countries must speed up their economic development in order to minimise the negative impacts on the environment of their economic growth. The energy sector will play a crucial role in their economic development but it is fundamental to establish an energy strategy that will not aggravate environmental problems. It is worth remarking that industrial countries agreed in the convention to provide developing countries with the necessary support to face this challenge. The Climate Change Convention offers a unique opportunity to enhance economic development without damaging the environment. It is our responsibility to make the Convention work.

Although there is no scientific agreement about the causes and consequences of the greenhouse effect, a minimum regrets strategy is most often suggested as an insurance policy against this potential threat to industrial society (Ortoli, 1992). In order to adjust their energy sector towards a minimum regret strategy, several European countries decided to stabilise their energy sector's CO_2 emissions by the year 2000. There is a strong hope among Europeans that their CO_2 target will soon be followed by both industrialised and developing countries. However, there are hints that this is perhaps an optimistic perspective. Indeed, the Americans still perceive that the cost of such a target is too much high (The Economist, 1992). Obviously, most developing countries are strongly concerned about this row among industrialised countries, since their ability to stabilise their CO_2 emissions in the foreseeable future is quite limited. Moreover, their actions in this field will be largely dominated by what the industrial countries will do.

As far as the energy sector is concerned, ESI (Electricity Supply Industry) is usually targeted as a focal point for environmental policy. The ESI is the single largest producer of CO_2, one of the main anthropogenic greenhouse gases, in industrialised countries and in many developing countries as well. Moreover, the ESI is the main sector in the economy in which there are large opportunities to diminish greenhouse gases emissions. Indeed, there are several studies which point out that technologies do exist to improve the end-use performance of electric appliances and to increase supply using renewable sources of electricity as well (as for instance Goldemberg et al., 1987). These are opportunities to increase the supply of electricity services to consumers with no additional emissions of greenhouse gases. It is our perception that performance improvement policies are the principal mechanism to gather these opportunities.

Recent trends in performance of the ESI of LDCs

In most LDCs, the ESI developed quite rapidly since the end of World War II. The assumption that electricity supply was a principal input for economic development led both governments and international aid organisations to significantly increase the supply of electricity in LDCs. Moreover, social tariffs have largely been used to foster electricity consumption among the poor strata of the population, specially in rural areas. This policy has had a dramatic effect on access to electricity supply of LDCs populations (de Oliveira, 1991). Except in Africa, urban areas of the developing world are almost universally supplied with electricity and large rural areas have had access to electricity supply as well. Despite these improvements in social performance, there are areas still with no electricity supply and electricity consumption per capita in LDCs is still extremely low as compared to industrial countries.

Electricity consumption made possible, substantial improvements in productivity and it produced a revolution in the social life of LDCs. Not surprisingly, strong political pressures remain to expand electricity supply in the developing world and most LDCs still have plans to rapidly expand electricity supply. Conversely, electricity consumption in industrial countries is expected to increase slowly. Consequently, the developing world shall be responsible for the largest share of the growth in world electricity consumption. Obviously, this trend engenders large concerns among industrial countries about the environmental impacts of the ESI in LDCs. Indeed, the last World Energy Conference, in Madrid, concluded that LDCs, growth in energy consumption is likely to be a substantial source of world environmental problems.

Compared to industrial countries, the environmental performance of the ESI of LDCs is still poor. Indeed, environmental issue is a relatively new which is quite often confronted with poverty, a more pressing issue from a LDC perspective. Despite this constraint, there are signs of growing concern with the environmental impacts of the ESI among LDCs. Policies oriented to reduce mainly the local (and in some cases the regional as well) environmental damages of electricity generation were recently introduced in Asia and Latin America (de Oliveira, 1992). The diversity of power generating technological mix in use among LDCs induces quite distinct policies however.

In India and China, where poor quality coal is commonly used, large amounts of SO_2, NO_x and fly ash are damaging air quality; large investments are needed to adjust existing power plants to environmental standards and regulations which are not fully enforced as yet. In Mexico and Thailand, thermal power plants are important sources of both SO_2 and NO_x gases; improvements in fuels quality is enabling a reduction in the environmental impacts of the ESI but more strong action will be needed if CO_2 emissions will have to be stabilised. In South America, hydropower dominates electricity supply and emissions of greenhouse gases by the ESI is low; however, there is strong concern with both the displacement of riparian population and the impact on wildlife provoked by large dams. In West Africa, there is still very little concern with the environmental impacts of the ESI since the power sector is relatively small.

The technical performance of the ESI and LDCs has had a mixed trend in the recent past. It improved in certain aspects but deteriorated in others. The thermal efficiency, for instance, is improving although it remains relatively low as compared to industrial countries. However, transmission and distribution losses increased as result of the rapid extension of lines to low density consuming areas as well as due to theft and pilferage. Reserve margins have reduced since investments in generating capacity were drastically cut back, despite growing demand for electricity. Interconnection, both domestically and internationally, was not entirely exploited in order to improve the reliability and quality of service. Moreover, although there are signs of improvement in end-user efficiency, no comprehensive electricity conservation policy has been established as yet in most LDCs. It is worth remarking that cogeneration, which is a substantial source of energy efficiency improvement, still faces strong institutional barriers in LDCs.

Economic and financial performance is a key factor since it governs the flow of indispensable financial resources for sustained development of the ESI. It is important to distinguish between those elements that are under utility control and those that are not. As far as the first set of indicators is concerned, there was a trend towards deterioration in performance, despite increases in electricity sales by employee. The capital cost of utilities increased substantially as result of construction delays and growing equipment and materials costs; operational costs increased since maintenance of power plants and investments in transmission and distribution lines were both neglected; revenues from electricity sales diminished as result of theft, pilferage and long lead times between billing and actual payment of electricity bills.

There was a substantial deterioration in economic and financial performance as result of policies decided outside utilities as well. Governments of LDCs reacted to the oil crisis, and subsequently to the debt crisis, with stabilisation policies that limited tariffs increase, despite substantial rise of both fuel and capital. Lenders reacted to the deterioration in financial performance reducing their flows of capital to the ESI of

LDCs in a period where investments were essential to put the ESI in a new technological trajectory. Obviously, these policies were not quite helpful, further aggravating the already difficult situation of the ESI of LDCs.

Getting out of the vicious circle

In the 1980s, the ESI of LDCs was plunged in a vicious circle of performance deterioration that is hindering its sustained development and aggravating its environmental impacts. Increase in fuel costs and capital costs, diminished growth in consumption and the internalisation of environmental costs are compelling governments in introduce institutional changes and utilities to move in a new technological trajectory.

Lenders have their view (mainly founded in the experience of industrial countries) on the sort of changes that are needed. Their main concern is with the re-establishment of sound financial flows to the ESI. They suggest that substantial increase in tariffs and privatisation of utilities are necessary policy guidelines. From their point of view, these policies will allow the ESI of LDCs to recover financial soundness and will induce improvements in economic performance (that will eventually lead to environmental, social and technological performance improvements) as well.

These policy guidelines are most often resisted by LDCs governments whose perception of the performance of the ESI is most often connected to their macro-economic, social and environmental impacts. Governments find it some what unrealistic to promote large increase of actual electricity tariffs in the context of high inflation. Moreover, there is a strong belief that the development role of the ESI is much too important to let the private sector govern the industry as yet. Indeed, there are strong political pressures for electrification that have to be accommodated and there are large externalities, particularly environmental impacts, that must be administered as well.

Utilities have a mixed reaction to lenders, policy guidelines. From their point of view, the performance of the ESI should be rated by its ability to rapidly extend electricity supply. Utilities are enthusiastic about any increase in electricity tariffs which will substantially improve their cash flow and eventually will support a rapid growth of the ESI. Nevertheless, they fear that privatisation will eventually increase their costs as a result of coordination between generations, transmission and distribution. In this case, lack of improvements in financial performance produced by higher electricity tariffs would eventually be impoverished by increase in costs induced by lack of coordination.

The conflict between these three perspectives is leading to further deteriorate in the performance of the ESI of LDCs. These three perspectives must be reconciled. Lenders must not discount the very substantial cost of macroeconomic stabilisation policies for the ESI. Government can not keep passing on to utilities costs that have to be paid by consumers and, where appropriate, by the Treasury. Utilities can no longer plan for rapid increase in their electricity supply, in a context which severely constrains their cash flow. The ESI of LDCs is passing through a transition period in which the costs of changing its technological trajectory have to be shared by lenders, governments, utilities and consumers.

From the institutional point of view, the ESI has to be reorganised in a framework that induces performance improvements. Utilities have eventually to bear the cost of their management mistakes; governments must pay the subsides for the costs induced by their political interference in the ESI; lenders must recognise that their loans cannot be protected from the costs of stabilisation policies. Such framework has to open

space for new actors (cogenerators, independent power producers, large industrial consumers) that will play a more active role in the ESI in the future. Government interference in utilities, daily life shall be limited by a regulator that must keep strong pressures for social, environmental, technical, financial and economic performance improvements.

Financially, tariffs have to increase but consumers must not be penalised by utility inefficiency, specially whenever there is overinvestment. Obviously, pilferage and theft must be strongly reduced and bills must be collected in time. A much wider range of tariffs must be created in order to offer to consumers the quality of service that would match their real needs.

Technologically, interconnection should receive top priority since it can produce substantial economic impact in the very short term. A comprehensive conservation policy will slowdown the pace of growth of electricity consumption and a policy that increases competition among both fuel and equipment suppliers which will reduce costs. The acquisitions of technological capability must be object of specific policy, specially as far as environmental technologies are concerned (Meier–Stamer, 1992).

Promoting environmental performance

The most effective way to improve environmental performance in LDCs is to foster their economic development. The ESI has a crucial role to play in this process but the vicious circle in which the industry is plunged is limiting its role. Indeed, there is little scope for investment if the trend of deterioration in performance is not reversed since investments are essential to put the ESI of LDCs in the new technological trajectory demanded by environmental concerns.

The ESI of LDCs is likely to increase their greenhouse gas emissions quite substantially if no action is taken soon. The scope for action is large. The hydropotential remains, to a large extent, untapped as yet both in Africa and in Latin-America and is substantial in Asia as well. Cogeneration is marginally used but has an enormous potential that can be rapidly exploited if sound policies are put in place. Thermal efficiency can be substantially improved if the quality of fuels used by power plants is adjusted. These opportunities for improvement in environmental performance are fully in line with improvements in social, economic and environmental performance.

Nevertheless, the current policies are not moving the ESI in the right direction. Indeed, lenders, governments and utilities are deciding their policies based on conflicting perspectives that can only keep the ESI on its vicious circle of deteriorating performance. For instance, lenders are inducing utilities to use high discount rates in their project evaluation. This policy will induce technological choice towards low capital intensive technologies. Under these circumstances, renewable energy sources such as hydropower will be penalised while fossil fuel power plants will be economically benefitted. Such a trend will increase the environmental costs of the ESI substantially.

A reconciliation of lenders, utilities and government policies is a fundamental step forward in effective environmental performance improvements in the ESI of LDCs.

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Perspectives on the Biodiversity Convention

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Introduction

The Convention on Biological Diversity, finalised at Nairobi in May 1992 after seven rounds of negotiations over the preceding two years, has evoked exceptional interest across the world. This interest has been aroused partly by the intrinsic appeal of the subject. Concern for flora and fauna, partly as a result of its being opened for signature. Coinciding with the UN Conference on Environment and Development held in Rio de Janeiro in June 1992; and partly because of the controversial North-South issues it deals with—encompassing, *inter alia*, sovereignty over natural resources, transfer of technology and additional financial resources. Attention has also focussed on it because of the refusal by the United States of America to sign the Convention at Rio. While different aspects of the Convention have been touched upon and analysed, its overall implications have remained somewhat hazy in most minds, not only because it is a complex document on an abstruse yet vast subject, but also because not many have been able to follow the dynamics of the negotiations. This paper seeks to present the basic structure of the Convention, while highlighting its main areas of coverage and interpreting their implications.

Expressed in simple terms, biodiversity is the total array of all living organisms whether plants, animals or micro-organisms, and includes diversity within species, between species, and among eco-systems. Human activities like habitat destruction, over-exploitation of natural resources, pollution of various kinds, and numerous other direct or indirect processes are now accelerating the depletion or extinction of species and changing the conditions for their evolution. While all species deserve respect regardless of their use to humanity or their intrinsic ethical/aesthetic value, the protection of bio-diversity becomes particularly important since in it may be locked the key to progress in medicine, agriculture and other fields.

By far the largest extent of biodiversity is to be found in the developing countries, who have borne and continue to bear the costs of maintaining this diversity. However, as a result of their superior research and technological capabilities, it is the developed countries who largely enjoy the economic benefits from its utilization. An understanding of this dual aspect of biodiversity should serve to clear up some misconceptions about the major concerns addressed by the Convention. It is not merely an agreement on conservation, nor simply a means to obtain biotechnology or additional funds. The Convention on Biological Diversity, in fact, is all of these and more.

Objectives

The objectives of the Convention were the outcome of intense negotiations and reflect a carefully balanced consensus. The objectives have been identified as '...the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies,

and by appropriate funding.' The three concerns being addressed are thus: (a) conservation, (b) sustainable use, and (c) the sharing of benefits. It is the third element which makes this Convention unique. For the first time, we have a multilateral legal instrument which establishes a truly global partnership aimed at the protection and utilization of natural resources. For the first time, the true value of biological resources, per se, is recognised, leading to the further acceptance that the benefits from the utilization of these resources must be shared equitably with those (i.e., the South) who have conserved those resources at considerable opportunity cost.

It is particularly noteworthy that the partnership so established also fully recognises and reaffirms the sovereign rights of States over their natural resources, as is clearly stated in the Preamble, the single Principle contained in the Convention and in other substantive clauses (e.g., Article 15 Para 1). The inclusion of that Principle, incidentally, marks the first time that Principle 21 of the Stockholm Declaration on the Human Environment(1972) has been incorporated in toto into a legally binding international instrument.

Conservation and sustainable use

The Article on Geneal Measures for Conservation and Sustainable Use requires each country, in accordance with its conditions and capabilities, to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity and to integrate 'as far as possible and as appropriate', the conservation and sustainable use of biodiversity into relevant sectoral or cross-sectoral plans, programmes or policies. To the extent possible and in the manner appropriate to it, each country is also required to identify and monitor components of biological diversity important for conservation and sustainable use. Such an identification and monitoring is also to cover processes and categories of activities which could have significant adverse impacts on biodiversity conservation and sustainable use.

The qualification 'as far as possible and as appropriate' contained in Articles (7-11 & 14) relating to conservation and sustainable use of biological resources does not imply a weak commitment to conservation but merely reflects the reality that not everything can be identified, monitored or conserved immediately. Furthermore, it provides the required flexibility enabling each country to undertake the necessary measures in a manner most suitable to it.

Article 8 of the Convention is devoted to in situ conservation and requires, interalia, the establishment of a system of protected areas requiring special measures for biodiversity conservation and the development of guidelines for the selection, establishment and management of such areas. A large number of other measures which would promote in situ conservation have also been identified in the same Article. The noteworthy development arising out of this Convention is that now special funding and other support would be made available, particularly to developing countries for such in situ conservation. For a country like India, which already has a comprehensive conservation programme and a well-defined network of protected areas, the additional resources will certainly be welcome as they would benefit our conservation effort.

Special measures for ex situ conservation have also been identified (Article 9). Ex situ conservation has been viewed as being 'predominantly' but not exclusively for the purpose of complementing in situ measures. Thus the possibility of undertaking ex situ conservation measures delinked from in situ measures has also been catered for. It is also of interest to developing countries such as India that measures for ex situ

conservation of components of biological diversity are required to be adopted, preferably in the country of origin of such components. Ex situ conservation would also receive financial and other support and the Convention specifically recognizes that such support should extend to the establishment and maintenance of ex situ conservation facilities in developing countries. This too would undoubtedly assist the greater involvement of India and other developing countries in promoting ex situ conservation.

A separate Article of the Convention addresses the issue of sustainable use of the components of biological diversity. Supportive measures to promote conservation and sustainable use have also been identified and these cover areas such as incentives, research and training, public education and awareness, technical and scientific cooperation, impact assessment.

Impact assessment and the minimising of adverse impacts have been covered in Article 14 of the Convention. As the chapter of Article 14 (1) makes clear, the provisions contained in its five subparas are to be carried out 'as far as possible and as appropriate' by each Contracting Party. The first subpara addresses the issue of EIA (Environmental Impact Assessment) and, where appropriate, allows for public participation in EIA procedures. The second subpara requires the introduction of appropriate arrangements to ensure that the environmental consequences of a State's programmes and policies that are likely to have significant adverse impacts on biological diversity are 'duly taken into account'. The following subpara addresses the issue of activities within the jurisdiction or control of a State which are likely to 'significantly affect adversely' the biological diversity of other States or areas beyond the limit of national jurisdiction. The fourth subpara requires that in the event of 'imminent or grave danger or damage' originating under its jurisdiction or control to the biodiversity of another State or areas beyond the limits of national jurisdiction, a State would immediately notify the potentially affected States and initiate action to prevent or minimize such danger or damage. The notification procedure has, however, consciously not been drawn out. The final subpara requires the promotion of 'national' arrangements for emergency responses to activities/events which present a grave or imminent danger to biological diversity. The role of international cooperation would be to 'supplement' such national efforts. Joint contingency plans would be established 'where appropriate and agreed to' by the concerned States.

During the negotiations a number of developing countries stressed the need to recognise the value of traditional knowledge and the contribution of the innovations and practices of farmers/local communities. This concept finds recognition in the Convention, which will seek to promote their application and an equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices.

It is also noteworthy that the Convention deliberately avoids all references, either explicit or indirect, to 'global lists', whether of biogeographic areas of special significance or of species threatened with extinction.

Sharing of benefits

This feature of the Convention is contained in two carefully phrased Articles which will probably undergo much analysis in coming months. The logic of these Articles is built around the fundamental acceptance of a State's sovereignty over its natural resources including, of course, its genetic resources. While each country would 'endeavour to create conditions to facilitate access to genetic resources and not to impose restrictions...', it is unequivocally stated that 'the authority to determine access to

genetic resources vests with the national governments and is subject to national legislation'. It must be remembered, however, that the basic purpose of the Convention is not to debar access to genetic resources but to promote it within the framework provided for in the Convention.

Since each country has sovereign rights over its natural resources, it is up to it to grant access to a particular resource or not. It now has the further right, before taking a decision, to invoke 'prior informed consent' procedures, which are well understood in international law. In this particular context, such procedures would require the Party seeking access to provide full information, inter-alia, about what is being sought, how and where it will be sought, by what method it will be extracted and in what quantity, what use it is expected to be of, etc.

Based on such information, and provided that a country does decide to grant access, such access would be on 'mutually agreed terms'. By itself, this does not amount to much, since a Convention is not required for States to enter into contracts on 'mutually agreed terms'. What the Convention lays down, however, are some parameters or elements which such agreements must address or, ideally, contain. In contract Acts at the national level (e.g., our Contract Act of 1872) certain minimum conditions are laid down for a contract to be valid, and the Convention attempts to do the same for contracts which involve genetic resources.

What are these parameters or elements? First, that research must be carried out in the country providing the genetic resource, as far as possible, but in any case with the full participation of that country. An obvious spin-off of this would be the development of research capabilities in the South. Second, the products resulting from the R & D on genetic resources should be shared in a fair and equitable manner with the country providing those resources. A clear example of such sharing would be in pharmaceuticals. Third, there should be a similar sharing of the profits (by whatever name) occuring from the commercial utilization of genetic resources. And fourth, the technology, including biotechnology, which is based on these resources must be transferred to the country providing them. It is in this fourth element that the question of IPRs (Intellectual property rights) has arisen, because the Convention provides that the technology to be so transferred includes 'technology protected by patents and other intellectual property rights'.

To understand the issue of IPR's as it occurs in this Convention, it may be useful to first consider the strcuture of Article 16. The first paragraph of this Article is a general one exhorting each Contracting Party to share technology (including biotechnology) with other countries both for the conservation and sustainable use of biodiversity and for making use of genetic resources in an environmentally sound way. Paragraph 2 deals with the terms on which such technology transfer should occur, i.e., on fair and most favourable terms, including on concessional and preferential terms where mutually agreed. If such technology is protected by patents or other IPRs, such IPRs should be adequately and effectively protected in the process of technology transfer. It should be kept in mind that paragraph 2 still refers to a general commitment towards technology transfer to developing countries on favourable terms, and not as a specific contractual or legal obligation under the Convention.

The specific legal obligation for technology transfer which this Convention creates is under paragraph 3 of Article 16 which states that where a country, particularly a developing country, has provided genetic resources which are then subjected to biotechnology, such technology must be transferred to that developing

country regardless of patents and other IPRs. The implication of this paragraph is that when entering into a contract for providing access to its genetic resources, a developing country can insist that it should receive the resultant technology even if protected by IPRs.

The intention behind paragraph 3 of Article 16 is further clarified by paragraph 4 which seeks to impose the same conditions on the private sector as each Contracting Party would have to follow under paragraph 3. Further, paragraph 5 makes a clear statement that patents and other IPRs should not impede the transfer of technology envisaged under Article 16 but should be supportive of the objectives of the Convention. In essence, paragraphs 3, 4, and 5, read together provide a new thrust in the IPRs debate because they establish a right on a particular IPR not only for the person (i.e., legal person) who has developed the process or product, but also for the person who has provided the unique material without which that process or product would not have been possible.

An important feature of these paragraphs is the reference to the financial mechanism to be established under the Convention. Unlike other environmental Conventions or Protocols the Biological Diversity Convention envisages the use of a financial mechanism to ensure that developing countries receive their fair share of benefits—a sort of insurance against unfair trade/business practices. Interventions by the financial mechanism can also help to top up, so to speak, the returns on investments in R & D that a company would normally expect but which may now be lower because of profit-sharing under the terms of the Convention.

In the ultimate analysis, contracts would still be on 'mutually agreed terms' and each country would carefully see where the balance of its interests lies. For example, a country may choose not to insist on the technology or access to products but accept a financial package instead. Another may prefer a lump-sum settlement rather than recurring royalties. Decisions would normally be on a case by case basis, and it will be interesting to see how the format of agreements in this regard evolves.

It has been argued that such contracts or terms could in any case have been insisted upon by a country allowing access to its genetic resources, even without a Convention. That is correct. But what the Convention does is to require the Parties receiving the resources to ensure that such arrangements are entered into. In other words, the developed world would have to require its creatures, whether individual or coporate, to see that the conditions stipulated by the Convention are fulfilled. The onus of ensuring benefit sharing will not be on the providers of genetic resources alone, but also on the recipients. To emphasize this point, the Convention specifies that for technology transfer in particular, the private sector shall also abide by the obligations on States Parties contained in the Convention.

Finally, a comment on which genetic resources are being referred to. Through definitions (e.g., of 'country providing genetic resources', 'country of origin of genetic resources' and 'in situ conditions') and a substantive clause (Article 15 paragraph 3), resources collected in the past and housed in genebanks have been excluded and will not occasion the reverse access to benefits which some have expressed fears about. Secondly, only those resources which have been legally provided under the Convention would attract the sharing of benefits, not those which may have been acquired accidentally or by theft.

Financial clauses

There would be a financial mechanism under the Convention, to assist developing countries to carry out the objectives of the Convention and to benefit from its provisions. The funding would be through 'new and additional' financial resources to be provided by developed countries. The funding mechanism would operate under the authority and guidance of the Parties, in a 'democratic and transparent' manner, and would be accountable to them. In brief, the mechanism would work entirely as a subsidiary organ of the Conference of the Parties, and not with a will of its own. The finer details would be decided upon by the Parties at their first meeting after the Convention has come into force. In the interim period (from the coming into force of the Convention till the first meeting of the Conference of the Parties) GEF (Global Environment Facility) would function as the financial mechanism, but only if it has first been restructured fully to meet the requirements of the relevant provisions of the Convention.

The financial mechanism envisaged closely resembles the mechanism established under the Montreal Protocol on Substances that Deplete the Ozone Layer, by the London amendments of June 1990. The agreement ultimately reached, after bitter wrangling, leaves the final decision to the Parties once the Convention has come into force, and the GEF is not ruled out as the required mechanism, provided it has been restructured in accordance with Article 21. A mechanism administered by the Parties does not necessarily imply that a new bureaucracy or institution has to be established. The mechanism can be operated by an existing institution but the method of operation would need to be fully guided and governed by the Parties.

Other provisions

It is noteworthy that the Convention establishes a 'subsidiary' body on scientific, technical and technological advice. This body, which would be multidisciplinary, is to function under the authority of, and in accordance with guidelines laid down by the Conference of the Parties, and would provide inputs upon the latter's request.

Rreporting obligations under the Convention have deliberately been couched in general terms and not spelt out in great detail. Contracting Parties are to present to the Conference of Parties reports on measures taken for the implementation of the provisions of the Convention and the effectiveness of such measures in meeting its objectives. The latter phrase is of particular relevance in view of the multiple objectives of the Biodiversity Convention.

A separate Article of the Convention makes clear that its provisions shall not affect the rights and obligations of any Contracting Party deriving from any existing international agreement, except where the exercise of those rights and obligations would cause a serious damage or threat to biological diversity.

The Convention provisions on settlement of disputes are phrased on traditional lines and largely parallel similar provisions contained in the Vienna Convention on Protection of the Ozone Layer(1985).

The Convention comes into effect ninety days after 30 States have become Party to it. No reservations may be made to the Convention. A Party may withdraw from the Convention two years after it has entered into force for it, and the withdrawal becomes effective a year later.

A useful beginning

The conclusion of the Convention on Biological Diversity, covering a vast and complex area which many at first considered was unlikely to lend itself to an international consensus, marks an important stage in efforts to protect the genetic resources of our world. Based upon the concept of global partnership, rejecting the 'common heritage' approach, and acknowledging for the first time the true value of biological wealth, it constitutes a significant development in international environmental law. The Convention is of particular interest to developing countries, where the greatest biodiversity is to be found, since it provides a framework by which they could benefit from the exploitation of their own biological resources. While the Convention would now need to be made operational, agreement on it is a move in the right direction, and reflects a delicate balance taking into account to the extent possible the interests and concerns of all negotiating parties.

An analysis of the Biodiversity Convention

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Introduction

This paper attempts to analyze the implications of the BDC (Biodiversity Convention), mainly from a developing country viewpoint. The Convention has addressed the problem of dwindling species diversity, sustainable use of genetic resources and set up a contractive framework for their utilization.

The Convention has laid emphasis on the sovereign rights of States over their genetic resources, simultaneously referring to biodiversity as the 'common concern of humankind'. From this follow the implications for national legislation to safeguard national interests as well as to facilitate the objectives of the Convention, stated as, the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the utilization of genetic resources, including appropriate access to genetic resources and appropriate transfer of technologies.

The Convention has addressed complex issues such as technology transfer, intellectual property protection, and biotechnology transfer in a manner which could be acceptable to developed ICs (or industrialized) countries which are technology rich and gene poor, as well as DCs (Developing Countries) which are gene rich and technology poor. This has left some issues unresolved, which may be subjects for future protocols. Some of these issues have been identified in this paper.

The paper also briefly discusses the role of indigenous communities in the conservation of resources and examines the implications of providing incentives to them, so that they may continue to play this vital role.

Biodiversity defined

Biodiversity is the totality of genes, species and ecosystems in a region. For the purpose of protection and conservation, biodiversity can be divided into three hierarchical categories: genes[1],species[2] and ecosystems[3].

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[1]Genetic diversity refers to the variation of genes within species. Alternatively it is the sum of genetic information contained in the genes of individuals of plants, animals and microorganisms. This covers distinct populations of the same species or genetic variations within a population.

[2]Species diversity refers to the variety of species within a region. Globally, this has been estimated to be between 5 and 50 million although only 1.4 million have been described so far.

[3]Ecosystem diversity relates to the variety of habitats, biotic communities and ecological processes in the biosphere. This is harder to measure than species or genetic diversity due to the "boundaries" of communities and ecosystems being elusive.

While in principle, human cultural diversity (i.e., attributes of human society such as cropping patterns land management practices, diversity in language, etc.) could count as biodiversity, the BDC does not deal with human culture as such, and accordingly we do not discuss this aspect further.

Distribution of biodiversity

The patterns of distribution of biodiversity have influenced the structure of the BDC. This is because of an overwhelming concentration of in situ biodiversity in DCs, constituting a valuable resource sought by ICs (Industrialized Countries). In ex situ conservation, on the other hand, ICs have an advantage.

In situ distribution

Globally the countries with the most species of vascular[4] plants are in the neotropics[5] (Central and South America) and in Southeast Asia, where most of the world's rainforests are located. Northern countries such as Canada, Scandinavia, and the former USSR, and southern temperate countries such as Chile and Argentina, have comparatively fewer species. Tropical forests, in particular closed tropical forests, contain at least 50% and perhaps 90% of the world's species. Mediterranean climate regions have very rich floras with high levels of endemism[6]. For instance the Cape region of South Africa has about 8,600 species of plants, of which 68% are endemic. Wetlands, although not known for their high species diversity or local endemism, are complex ecosystems.

Marine ecosystems, in particular coral reefs, are comparable in diversity to tropical forests having a high diversity at the higher taxonomic[7] levels than even terrestrial ecosystems. Islands are known for having some very endemic flora with very few of their species being found elsewhere. They also have the unfortunate distinction of having the highest number of recorded extinctions.

It is this unevenness of the distribution as well as extinction of genetic resources which has led to the setting up of ex situ conservation sites.

Ex situ distribution

Ex situ distribution is another means of conserving biodiversity. This is done both in international germplasm and private collections. This method of conservation is encouraged only to a limited extent in the BDC. While the issue is yet unresolved, till now free access to international collections is allowed. Private (and national) collections do not, in general, allow free access.

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[4]Those plants having vessels which convey fluids.

[5]Refers to the New World Tropics

[6]Those organisms occurring permanently in an area

[7]During the classification of living organisms they are placed in different categories known as taxa

Declining biodiversity

Tropical deforestation is the principal example of endangered biodiversity. Although the extent of forest cover in the northern temperate and boreal regions has not changed significantly in recent years, there has been a replacement of older forests by second growth forests and plantations, leading to species loss. In Mediterranean climate sites, such as California, South Africa, Southwest Australia, and Central Chile, at least 10% of all species are in danger. The largest number of recent extinctions has been on oceanic islands, 60% of plant species endemic to the Galapagos islands, 42% of the Azores, and 75% of the species on Canary Islands are endangered (WRI 1992–93). About 10% of the vascular plant species endemic to Hawaii are extinct and 40% are threatened. Freshwater ecosystems are threatened by pollution and introduction of alien species.

The loss of biodiversity could be attributed to direct and indirect causes[8] i.e., habitat loss and fragmentation, introduction of exotic species, overexploitation of species, pollution, and climate change.[9]

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[8]Report on Global Biodiversity Strategy; Guidelines for action to save, study and Use Earth's Biotic Wealth Sustainably and Equitably. WRI, The World Conservation Union (IUCN), United Nations Environment Programme (UNEP) in consultation with FAO, United Nations Education, Scientific and Cultural Organization (UNESCO) 1992.

[9]a) **Habitat loss and fragmentation**

An FAO/UNEP estimate(1982) is that globally 11.1 million ha are eliminated outright each year, and at least a further 10 million ha are grossly disrupted annually [WRI/WWF]. The major loss could be attributed to the expansion of marginal agriculture, and due to commercial timber harvesting. between 1961 and 1985.

b) **Introduced species (exotic)**

This is particularly frequent in the case of islands, where an alien species could endanger those species which have not co-evolved together. In Hawaii the 86 introduced plant species constitute a threat to the endemic biodiversity; one such introduced tree species having already displaced more than 30,000 acres of native forest.

c) **Overexploitation of plant and animal species**

Increased pressure on natural resources have been another cause endangering biodiversity. The population and catch of the Peruvian anchovy has dropped radically due to overexploitation between 1958 and 1970. Apart from having a major function of serving as food, occasionally a resource may serve as a collector's item causing its extinction as in the case of the Sumatran and Jawa rhinos.

d) **Pollution of soil, water and the atmosphere**

Pollutants stress ecosystems reducing or elimimating those species sensitive to the altered conditions. Acid rain has been instrumental in causing the death of a significant amount of fish life in the Scandinavian and North American lakes, apart from the destruction of extensive forest cover. Marine pollution has affected the Mediterranean sea and even estuaries entering other seas.

e) **Global climate change**

Climate change in the form of increased temperature 1–3^{0}C is likely to alter the limits of tolerance of land species approximately 125km towards the poles, or 150m on the mountains. It is anticipated that the rapidity of the change would not allow for adaptation or redistribution of some species. Sea level rise could also affect low lying areas and may cause the submergence of some flora and fauna.

f) **Industrial agriculture and forestry**

Modern agriculture have been characterised by plant breeding programs aimed at increasing levels of productivity. These limited varieties of crops have wide adaptation and are responsive to high levels of inputs. Their limited diversity is in itself the cause of danger. Similarly, in the forestry sector, natural forests are increasingly being replaced by monocultural plantations.

The rest of this paper is structured as follows: Section 2 discusses the broad structure of BDC. Section 3 deals with some general issues and how they have been dealt with in the BDC. Section 4 discusses aspects of conservation, while Section 5 examines national and multilateral commitments. The contractive framework is analyzed in Section 6. Section 7 looks at intellectual property right concerns related to life-forms, and their resolution in the BDC. Section 8 discusses the treatment of special country groups, and Section 9 examines the treatment of indigenous communities. The last section attempts to both assess and identify subjects which may be included in future protocols.

Broad description of the BDC structure

The text of the BDC is broadly structured as follows: Commencing with a Preamble which lists the guiding principles to be followed in the Convention, it is followed by 42 operative Articles and two Annexes. Article 1 deals with objectives of the Convention, and Article 2 defines some of the terminology used in the document. Article 3 states the overarching principle of sovereignty of States with respect to biological resources in their jurisdiction, subject to the qualification that their activities do not cause environmental damage outside their jurisdiction. The remaining articles deal with identification and monitoring of components of biodiversity, conservation (in situ and ex situ), access to genetic resources and technology, handling of biotechnology, financial resources, financial mechanism, and relationship with existing agreements. Annex 1 lists important components of biodiversity, and Annex 2 furnishes the provisions for arbitration.

General issues and their treatment in the BDC

Objectives

Genetic materials are a principal input in biotechnology research, which in the last decade has assumed major economic importance. In the process, the winners have been developed countries with R & D capabilities in biotechnology, and IPRs rights over them. The losers have (typically) been DCs, which have been the source of genetic materials. Waehle[10] cites the example of the Rosy Periwinkle (*Vinca rosea*) from Madagascar, a plant which now forms the basis of a US $100–160 million drugs industry, while the local people in Madagascar have received virtually no economic benefits from the same.

At the same time, there has also been marked loss of species diversity, particularly in the last several decades. This is attributable largely to human (economic) activities, as detailed above.

The objectives accordingly are to both conserve genetic wealth, as well as assure access to the resulting biotechnology, besides regulating access to the genetic materials themselves.

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[10]Towards a Green World: Should Global Environmental Management be built on Legal Conventions or Human Rights? CSE Publication.

Sovereignty

Common heritage of mankind vs national property

The question of sovereignty as it relates to genetic resources is whether they are to be treated as 'open access' global common property (as implied by the term: 'common heritage of mankind') or as it belonging to the concerned State in which they are located (national property).

The principal argument for open access global common property is that genetic material is a non-excludable, non-rival good. In other words, since researchers need only small amounts of genetic material (a few seeds), the use of the resource by an individual agent does not reduce the quantity of resource available to others, making it a non-rival good. It is also non-excludable simply because in practice it is impossible to prevent physical access to genetic material under in situ conditions. Treating genetic materials as global common property will, however, pose two difficult questions. First, the question of apportioning responsibility for costs involved in their conservation, and second, in sharing the economic benefits from their utilization.

The argument for treating these resources (i.e., those located within national jurisdictions) as national property is as follows: First, DCs clearly have some leverage over ICs due to their greater endowments of biodiversity. Treating the resources as national property may enable DCs to reap economic benefits from their use by ICs, without trying to resolve the difficult question of equity in sharing global common property resources. Second, that regulation must be initiated for conservation of resources because of the alarming extent of species loss. Such regulation must depend on national authorities, whose responsibilities can be better focused for national, rather than global common property resources.

Most nations had earlier supported free access to 'unimproved germplasm' in wild species or traditional varieties of crops or livestock. At the 22nd FAO Conference in 1983, two resolutions 8/83 and 9/83 were passed. Resolution 8/83 put forth the 'International Undertaking on Plant Genetic Resources' which was an attempt to bring the current network of gene banks under the control of the FAO. The objective of this agreement was to ensure that plant genetic resources of economic and social interest, particularly for agriculture, would be explored, preserved, evaluated, and made available for plant breeding and scientific purposes. The articulated basis of the document was the principle that 'genetic resources are a heritage of mankind and consequently should be available without restriction'.

Status of sovereignty according to BDC

The Convention (Article 3) clearly affirms that States have sovereign rights 'to exploit their own resources', which may be interpreted to include biological resources in national jurisdictions. This strong affirmation is qualified by the requirement that they have the responsibility to ensure that activities within their jurisdiction or control do not cause extra-jurisdictional environmental damage. They are also responsible for both conservation and sustainable use of these resources. They thus have the authority to determine access to such resources. Where access is granted it would be on 'mutually agreed terms' and subject to the 'prior informed consent' of the contracting party supplying the material (Article 15). Clearly, countries of origin have no rights over genetic material already in ex situ collections, outside the country.

Genetic resources in international and private germplasm collections[11], have not been adequately dealt with in the BDC. From the statement on relationship with other agreements (Article 22) it would seem that the matter is unresolved because there is no prior multilateral agreement on the subject.

The BDC acknowledges that the conservation of biological diversity is the 'common concern of mankind'. While this expression justifies international cooperation for conservation, the eschewing of the term 'common heritage of mankind' rules out any possible interpretation of genetic resources as global common property.

'Precautionary principle'

The precautionary principle calls for action in meeting the BDC's objectives even in the absence of complete scientific certainty, wherever there is a threat of significant reduction or loss of biodiversity, so that the threat is avoided or minimized. The alternative is to 'wait and see' whether further research resolves uncertainties sufficiently that the costs and benefits of actions can be unambiguously determined. The pros and cons of observing the principle are as follows:

The argument in support of the principle is that loss of genetic wealth exposes humanity to risk and possible but uncertainly large economic losses. It would justify some expenditure even in the absence of scientific certainty, in order that the risks are significantly reduced and major losses averted.

On the other hand, the diversion of resources towards conservation at the cost of other developmental requirements, could be a reason for awaiting more information, prior to taking action.

The BDC opts for the precautionary principle, rather than the 'wait and see' alternative. It is sited in the Preamble, rather than in specific operative Articles. This may enable, when alternative interpretations of commitments or other operative provisions are possible, to favour an interpretation involving the precautionary principle, rather than the alternative.

Conservation (sustainability) concerns

The BDC seeks the conservation of biodiversity in order that it may be utilized for human welfare (Preamble, Articles 1, 2 and reading also the Rio declaration: 'human beings are at the centre of sustainable development concerns'). The Convention is, thus, categorically anthropocentric in perspective, and does not acknowledge (legal) rights of any other (living and non-living) entities.

'Sustainable use' has been defined (Article 2), as the use of components of biological diversity in a way and at a rate that does not lead to the long term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. Incentives to promote the sustainable use of biodiversity, are to be provided by the adoption of 'economically and socially sound measures'.

[11]In this instance information is not as easily available as in the case of the public sector gene banks. Such information may constitute trade secrets.

Identification and monitoring

The purpose of identification and monitoring is two fold. First, to locate components of biological diversity significant from the point of conservation and sustainable use, as well as focus on those components requiring urgent conservation, and having the maximum potential for sustainable use (i.e., economic benefit) (Article 7). Second, to monitor processes and activities which have a deleterious impact on conservation and sustainable use of biodiversity (Article 7). Contracting states are required to undertake such identification and monitoring activities. This data is to be tabulated and organized, facilitating utilization. This commitment may be fulfilled, in the case of DCs, only if and to the extent, financial resources for meeting the 'agreed full incremental costs' are made available by ICs (Article 20).

The functioning of the INBio (National Biodiversity Institute), at Costa Rica [1] could serve as a role model. The concerned organisation could establish a national inventory of the country's biotic wealth and conduct periodic assessments of current status. This would influence decisions regarding granting accessibility to a particular resource, at a particular point of time. Apart from this, the expertise of such a a professional organisation would help ensure that the potential value of the resource is correctly assessed.

In situ and Ex situ conservation

Apart from the establishment of protected areas for the protection of biological diversity the Convention refers to the regulation, management and development of such resources both within and outside such areas, for in situ conservation (Article 8). For such conservation, international cooperation is envisaged, including financial support to DCs, to the extent of 'agreed full incremental costs' (Articles 8 and 20).

Ex situ conservation measures are meant to complement in situ measures, preferably in the country of origin. Two reasons for preferring the country of origin for locating the ex situ effort are: First, this may aid in the recovery and rehabilitation of threatened species and their reintroduction into natural habitats. Second, the property rights of the country of origin over the resource would not be diluted because it would not leave national jurisdiction. This would act as an incentive to conservation.

The BDC stresses the regulation and management of collection from natural habitats, so that existing ecosystems and in situ populations of species are not threatened.

DCs are also encouraged to have such ex situ collections, by the provision of financial and other support.

Equity concerns

While acknowledging that DCs require access to and transfer of technology and financial resources (as a prerequisite to meeting their commitments under the Convention), the question is whether the BDC has adequately answered equity concerns. Equity issues are raised in the questions of, first, access to genetic resources (in situ and ex situ), second, access to R & D and its commercial benefits, third, equity across generations in the sense of resource sharing, and finally, equity concerns relating to rights of indigenous communities. Some of these aspects are dealt with elsewhere in this paper.

The question of access to genetic resources is linked to the assignment of property rights over the resource. When the Convention comes into force, the country

of origin gains the right to regulate access to in situ resources and the same is true for the country of location except in the case of private and international germplasm collections. In effect, the country of origin loses all claims to ex situ resources not located in its jurisdiction. This reflects the earlier general practice of treating these resources as 'open access', rather than national property. Given that the process of ex situ conservation did not violate the then existing property rights, it can be argued that procedural equity considerations (rights) should prevail over intuitive notions of substantive equity, which might allow countries of origin to retain property rights over ex situ resources. However, this argument may have important implications for equity in other global environmental issues, e.g., climate change, since it might tend to support status-quo or 'grandfathering' rights over global resources.

The question of equity in access to R & D and commercial benefits resulting from utilization of genetic resources from another country is sought to be determined by setting up a contractive framework in the Convention. This framework enables contracts for technology transfer and commercial benefits of R & D on the one hand, and access to the enabling genetic resources on the other, to be negotiated. Equity might be considered to be attained if such contracts are negotiated under fair procedures. Whether the playing field set up is level from the perspective of DCs, is discussed below in Section 6.

Inter-generational equity concerns are sought to be realized by adopting a conservation and sustainable use strategy, by means of which long-term decline of biodiversity may be arrested. If these resources can be maintained in perpetuity, it may be argued that the inter-generational concern is substantially taken care of.

The equity issue of rights of indigenous communities over resources which they have husbanded for generations and on which they are dependent is discussed below, in Section 9.

Multilateral and national commitments

The BDC stipulates commitments for developed and DCs separately, although as discussed below, the basis for classification is yet to be determined. The more important among the commitments are as follows:

Multilateral commitments

Under the BDC, developed countries shall provide and/ or facilitate under 'fair and most favourable terms', access to and transfer of technologies relevant to conservation and sustainable use of biodiversity to DCs. For technologies under IPRs protection, access and transfer would be on terms which 'recognize and are consistent with their adequate and effective protection'. In other words, such technologies do not enter the public domain solely on account of the Convention, requiring their transfer to DCs. Clearly, therefore, sidepayments would be required to persuade the IPRs owners to part with these technologies.

Accordingly, the Convention provides for 'new and additional financial resources' (Article 20) to enable developing country parties to meet the 'agreed full incremental costs' of meeting (all) their commitments. The questions of financial commitments and the possible interpretations of 'full incremental costs' are discussed in greater detail in below.

The list of developed countries (including countries in transition to a market economy) would be finalised after the first meeting of the Conference of Parties. The criteria for burden sharing amongst the developed countries remains undetermined.

National commitments

According to the BDC responsibilities at the state level would include, first, development of national strategies for conservation and sustainable use, second, integration of conservation concerns in policy making, third, establishment of protected areas and the like to conserve biodiversity, fourth, necessary domestic legislation for conservation, and finally, promoting public awareness of biodiversity conservation.

Implementation of these commitments by the DCs is contingent on the developed countries meeting their own commitments relating to transfer of technology and financial resources. Unlike in the Climate Change Convention, in the provision regarding finances for meeting incremental costs, there is no diluting caveat like 'as far as possible or as appropriate'.

Financial mechanism

The BDC requires developed countries to provide 'new and additional financial resources', reasonably interpreted as funds exceeding current patterns of development assistance, for meeting the 'agreed full incremental costs' incurred by DCs in meeting their respective commitments. Agreement on such incremental costs is to be reached between a financial mechanism set up under Article 21, and the concerned developing country. Norms for computing incremental costs would need to be worked out by the Conference of Parties.

The institutional structure for the financial mechanism is to be decided upon by the Conference of the Parties at its first meeting. Till that time a restructured GEF may function as the financial mechanism.

The major, essentially political, issue regarding the institutional structure of financial mechanisms in global environmental regulation, is the question of 'democratization'. DCs, in general, perceive a bias in the Bretton Woods institutions in favour of donors' interests, and are insistent on 'democratization', one interpretation of which is change in voting rules away from the IMF/World Bank scheme of weighted voting to the General Assembly norm of 'one country one vote'.

Since DCs are numerically dominant in the UN system, this norm would potentially confer greater weight to points of view on which they can reach consensus. On the other hand, DCs are more heterogenous and have more divergent interests than developed countries, and the prospects of them reaching strong consensus on almost any issue are weaker than for developed countries. Accordingly, while democratization is important for legitimizing the international standing of the financial mechanism, it may have less impact on the nature of outcomes than might at first sight be supposed.

Interpreting 'agreed full incremental costs'

An obvious subject for future protocols is the adoption of norms for '(Agreed) Full Incremental Costs' of measures by DCs in fulfilling their commitments under the BDC.

Economists would generally agree that a minimum notion of such incremental costs would first, define net benefits as 'opportunity costs', i.e., the costs foregone from not placing a given resource (e.g., an ecosystem) employed for, say, conservation purposes as a fulfilment of a commitment under the BDC, rather than in the best

alternative use (e.g., 'farming'). Opportunity costs may thus be contrasted with direct financial costs. Second, that such costs must be broadly defined, including goods which may be priced in markets, as well as those for which no (explicit) markets exist. Third, that all valuations of costs must be specific to the economy, and not based on (imported) norms. Fourth, that social discount rates at which streams in time of costs (benefits) may be collapsed to present values, are parameters of (explicit or implicit) choice for the concerned country, and cannot be prescribed by outside agencies.

Differences may arise on the question of whether the value of associated tangible but non-marketed benefits, for example improvement in local environmental quality, or benefits whose (future) market value is highly uncertain, (for example conserved genetic diversity), are to be netted out of computations of costs.

Further, DCs may face various constraints in adopting even clearly established 'no regrets' measures, i.e., measures which yield increase in economic efficiency over the conventional practice. These may include the fact that the up-front capital costs of some measures may exceed that of the current practice, and may not be adopted by DCs due to capital availability constraints. Non-concessional financial flows to deal with such constraints may increase the risk of future BOP (Balance of Payment) difficulties through debt servicing. Alternatively, additional investments in infrastructure, human capital, and rehabilitation, may be necessary before (say) conservation measures may be adopted. Unless these are adequately captured in norms of incremental costs, DCs may be unwilling to undertake such measures.

An additional aspect of defining incremental costs relates to the depth and other conditions of technology transfer for meeting commitments. The respective IPRs holders may prefer to capture the rents through export of capital equipment embodying the technology, rather than transfer of knowledge. The reasons for such a preference may be several. On the other hand, several DCs may be confident of being able to absorb technological knowledge to the extent of R & D capability in the same, and prefer, again for various reasons, in-depth transfer of technological knowledge to (say) import of capital equipment. Because of the preference of IPRs holders for transfer of machinery rather than knowledge, the element of rent involved in transfer of knowledge may be higher. Norms for defining incremental costs would have to reckon with this aspect also.

The contractive framework

At the heart of the BDC, distinguishing it from other global environmental agreements, for example the Montreal Protocol, or the Climate Change Convention, is a framework for trading access to national genetic property with the resulting technology and/or commercial benefits. This contractive framework is set up in Article 16.

The BDC appropriates genetic resources located in national jurisdictions (except international and private ex situ collections) to national authorities. However, the principal problem in setting up a contractive framework is that access cannot be physically prevented (since biotechnology requires only very small quantities of material, a few seeds), or alternatively, that IPRs categories (for example trade secrets protection) exist under which disclosure of use of specific genetic resources is not necessary.

One interpretation [of Article 16 (3)] is that the BDC disallows the use of IPRs instruments which do not insist on disclosure sufficient to enable replication of the covered (process or product) by other researchers. However, the provision is rather

opaque, and may lend itself to alternative interpretations. Even if this is not the case, in our view, it will be difficult for DCs to realize transfer of resulting technology in depth, or a significant part of the commercial benefits (rents) from use of the genetic resources. This conclusion is explained below:

Access to genetic resources and transfer of technology is to be on 'mutually agreed terms', meaning that the sidepayments that may be involved, as well as terms of transfer of (resulting) technology, are to be negotiated between the concerned States. Further, the sidepayments may be made (at least partly) by the financial mechanism, rather than directly or solely by the gene users.

One may note that there will be a clear asymmetry of information between the gene supplier and the agent developing the biotechnology, notwithstanding the fact that supply of genetic resources is to be with 'prior informed consent' of the supplier. The latter would, at the time of negotiations, have already completed a significant amount of research, know fairly well what it was looking for, and benefitting from the provisions of the BDC facilitating mapping and organization of genetic information, a reasonably good idea of the chances of finding it. The developing country negotiators in such contracts would have lesser information, since much of it would be proprietry to the potential user, and would hardly be equals in the negotiations, since they would have little idea of the true value of the resource.

Second, is the question of whether the requirement of (compulsory) transfer of technology enhances the bargaining strength of DCs. Technology transfer may occur in several varying depths and modes. Thus, transfer may occur through direct investment to a captive unit, or through sale of capital goods embodying the technology, or it may involve designs and specifications permitting their manufacture. Alternatively, it may include R & D skills. Some of the other negotiable dimensions of technology transfer are duration, geographical limits, and volume of production of the licensed technology. The Convention is silent on these aspects.

Suppose that disclosure of use of genetic resource is, in fact, effectively mandated. In that case, biotechnology innovators must negotiate with the gene supplier regarding sidepayments and depth of technology transfer, in return for access to the gene pool. The gene supplier may be prepared to trade-off reduced depth for increased sidepayments, but would start with the disadvantage of not knowing the gene pool's worth. It would, therefore, very likely make trade-offs along an indifference contour which at every point is below that which would be the case if it had full information. The latter, on the other hand, having revealed less than the gene pool's true worth, would also prefer to trade-off reduced depth for increased sidepayments within the disclosed valuation of the resource, since at least part of the negotiated sidepayments may be paid by the multilateral fund. If the administrators of the fund do not intervene, the likely result is only nominal depth of technology transfer and low level of sidepayments.

However, the administrators of the fund may seek to eliminate such free rides on its finances by the gene users. Accordingly, they may attempt to negotiate norms both for sidepayments, as well as depth of transfer (which, as pointed out above, may also be an issue in defining incremental costs). In this, developed countries would collectively reveal less than their true valuations for access to genetic resources, and may also attempt to protect gene users' rights by proposing restrictive norms for depth of technology transfer. Since DCs would not know the true valuation of the resource,

and collectively have little taste for increasing depth at the expense of sidepayments on offer, the process of evolving norms may only tend to freeze the earlier outcomes.

Further, even if such norms do not emerge and all sidepayments are directly paid by gene users, since rents from IPRs can be captured equally by sale of goods involving the technology, or by licensing it, the negotiated sidepayments would have the element of royalty built into it, reducing the amount. One further consideration is the potential for violating the terms of technology transfer, for example by exports to third countries (which may have been disallowed in the technology transfer contract). If technology suppliers believe that such risk is significant, they will attempt to cover it by a premium, reducing the sidepayments still further.

Intellectual property rights concerns about rights over life-forms

There are two distinct areas under IPRs protection which are of concern i.e., those over a genetic resource (biological resource property), and those over the intellectual contribution to the development of resultant technology (intellectual property).

We first consider IPRs protection for genetic information. Can the discovery of a new species of butterfly, for example, qualify for IPRs protection? Would such IPRs help conservation? An answer to the first must consider that such discoveries do not answer the criteria of an inventive step, or that of repeatability and description of the IPR subject (which may alter sufficiently from one generation to the next that specific descriptions would not be valid). Also, they do not have industrial application, at the point in time of discovery. There are also ethical problems with the grant of such IPRs on natural life forms, about which there is no prospect of general agreement.

Notwithstanding the above, several national IPRs regimes recognize as approbriable, some types of biotechnological discoveries and inventions. These include: naturally occurring and altered microrganisms, plants, animals and other biological material; biological processes for the production or modification of various products; and commercial use of such products. The legal forms of protection are in the form of plant breeders' rights, plant patents for asexually reproducing plant varieties, and 'utility patents' relating to use of the species or variety (including products).

One of the criteria of patentability is that of sufficient disclosure (i.e., enough information should be conveyed to allow a skilled person to either perform the process or make the product for which the patent is granted), which is often difficult to meet in the case of biotechnology. This may be due to the impossibility of fully describing the living material, and of providing access to it by means of the written word alone. This problem has been overcome to some extent by the use of culture collections as patent depositories for microrganisms and other incompletely describable biological materials. However DCs may lack the capacity to verify the source of such material in these depositories.

For reasons discussed above, granting IPRs protection to life-forms is not yet generally allowed. Many national laws exclude plant and animal varieties, and biological processes for the production of plants and animals, from the scope of IPRs protection.

Treatment/resolution of such issues in the BDC

The BDC does not explicitly address the issue of patenting of live organisms. At several places, however, it affirms that IPRs protection over biotechnology (which

under the BDC may include technology using living organisms) remain untouched [Article 16 (2)]. Such IPRs may apparently be prospective, and not only existing.

The BDC affirms that it does not affect the rights (obligations) of the Parties conferred under existing international agreements (Article 22), except where such exercise of rights (obligations) would seriously damage or threaten biodiversity. Since the Uruguay round on GATT is yet inconclusive, there is a clear need to harmonize its provisions relating to IPRs over life-forms and biotechnology with those of the BDC.

One important existing international agreement relating to life-forms is the UPOV (International Union for the Protection of New Plant Varieties) Convention (1961). This Convention allows for a 'breeder's exemption' i.e., the right of other breeders to experiment with the protected variety. It also confers a 'farmer's exemption' i.e., recognizes farmers' contribution to the selection and conservation of genetic diversity of crops by allowing them to store and resow seeds taken from the initially protected crops. These constitute important limitations on exercise of IPRs rights over a major commercially significant life-form, and the BDC clearly does not disturb such restriction.

Country groups

Country groups identified in the BDC include developed and developing countries. CITS (Countries in Transition) are not a subset of developed countries, although they may opt to assume commitments identical to theirs. LDCs ('Least Developed Countries') and SIS ('Small Island States') are subsets of DCs. The former would presumably be distinguished on the basis of social and economic criteria, and the latter by geography. A separate category for SIS may be justified by the fact of their higher vulnerability to biodiversity loss.

Developed and DCs

Developed country parties would provide the financial resources to enable developing country parties to meet the 'agreed full incremental costs' of implementing measures, in fulfilment of their obligations under the Convention. The extent of implementation by DCs is dependent on the former honouring the commitments of financial support and transfer of technology, subject to the rider that their overriding priority is development and poverty eradication. A list of developed countries (and others willing to undertake the obligations of developed country parties) would only be finalised at the first meeting of the Conference of Parties. As noted earlier the basis of burden sharing among developed countries is yet unresolved. This too represents an interesting aspect of equity in global environmental issues. Further, since criteria would have to be evolved for classifying countries, the evolution of the yardsticks at future negotiations is also a matter of significance. Interesting questions remain as to whether the lists would be static or dynamic, whether there would be provisions for review of criteria, whether single attributes (per-capita income or GDP) or multiple attribute (incomes, literacy, economic structure, life expectancy etc.) would be employed, and so on.

Least developed countries, a category in the class of DCs which remain to be identified, are allowed 'special consideration' in the matter of funding and transfer of technology. What exactly constitutes such special consideration? The matter would have to be resolved in several fora in the future.

Small island states

Small island states have been awarded special treatment within the category of DCs due to their unique situation characterized by highly endemic flora and fauna, and high species diversity (due to their geographic isolation), leading to their special vulnerability to biodiversity loss due to climate change and other causes.

It has already been noted that the largest number of recent extinctions have been on oceanic islands.

Indigenous communities

Approximately 200 million indigenous peoples live in and have special claims to territories, that in many cases have exceptionally high levels of biodiversity. Their claims are based on their long occupation of the territory, their apparent ability to manage the available resources sustainably, including conserving genetic resources over millenia, and their traditional knowledge of use of plants and other biological species.[12]

The Convention recognises their dependence on biodiversity, and the desirability of sharing equitably the benefits from use of traditional knowledge {Preamble}. It recommends that States should (subject to national legislation) respect and maintain the knowledge and practices of such peoples, promote their dissemination, and encourage the equitable sharing of the benefits of such knowledge (Article 8j). Clearly, these provisions fall well short of conferring anything like internationally acknowledged property rights over either biodiversity resources conserved by such communities, or their traditional knowledge of the uses of such resources. Of course, since the biological resources are the national property of the concerned States, by domestic legislation, individual States may confer such rights on their indigenous peoples. Further, States may also develop innovative IPRs regimes to give rights to these communities over their traditional knowledge.

Why is it that despite much clamour from several quarters that IPRs rights should be conferred on indigenous communities, this has not been done in the BDC? Apparently, on considerations of substantive equity, such communities should be entitled to a share of the commercial benefits from use of their knowledge, and one way of ensuring this is by conferring suitable rights.

While the equity argument is unexceptionable, one needs to note that as far as biological resources are concerned, international conferment of property rights to them would dilute notions of State sovereignty over biological resources in their jurisdiction. Further, outside parties seeking access to such resources would, in negotiating terms of such access, usually face an even less equal party in terms of information regarding the potential value of the resource, than would be the case if they negotiated with State authorities. If States can be believed to be honest trustees of the welfare of their

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[12] (a) According to the WRI,(1992–93) residents of one forest village in Thailand eat 295 different local plants and use another 119 for medicine. The World Health Organization has estimated that approximately 3,000 plant species are used for birth control by tribal people around the world.

(b) An index of the enormous potential knowledge amongst such communities is the fact that the National Institute of Health, U.S. has sent experts to all parts of the third world to interview traditional medical practitioners and gather herbs having an anti-tumour activity. Since the last five years the US National Cancer Institute has gathered more than 1,500 medicinal plants from tropical forests and peoples at about $418 a plant.

indigenous peoples, equity would be better served by requiring access to be negotiated with State authorities. One key issue in this context is the question of empowerment of indigenous communities within the domestic political structures.

Regarding rights over traditional knowledge, two issues are important. First, it is very likely impossible to devise an effective system of monitoring the use of traditional knowledge in the development of new products or processes by outsiders. Second, if IPRs rights are to be conferred on traditional knowledge, the way is open for claims of IPRs protection over other categories of knowledge which are now not recognized as approbriable. These would include, for example, basic scientific knowledge, including that discovered long ago. Clearly such unlimited proliferation of the domain of IPRs would be severely detrimental to the interests of DCs.

One other argument supporting the conferment of rights to indigenous communities arises from the need to ensure their continuing participation in conserving biodiversity. Such rights would serve as an incentive to local communities, facilitating innovation as well as conservation. In these communities the key to successful conservation is making sure that they share the benefits fairly and do not shoulder a disproportionate share of the costs [11].

Conclusion

Our analysis of the Convention draws attention to the imperative need for clarification of IPRs disclosure requirements under the contractive framework.

Some of the other concerns which would require to be the subject of future protocols are, first, that codes of conduct should be developed for collection of germplasm, and release of Genetically Modified Organisms (GMOs). Second, regarding ownership of existing germplasm located in international collections more clearly defined. Third, regarding norms for depth of technology transfer must incorporate DC concerns. Finally, definitions for and norms of incremental costs of measures in fulfilment of commitments.

Attention has been drawn to the need for a centralised national agency on the lines of INBio for sreening national genetic material and regulation of collection. Such a national agency would facilitate the compilation genetic material, aiding the government in identifying and assessing the value of such resources, and in regulating collection. In this way collection could be channelised through a single institution and there would be accountability to the concerned government owning the resource.

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Incremental costs of GHGs abatement programs: a first cut at a definition

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Introduction

In June 1992, the Framework Convention on Climate Change was signed at Rio de Janeiro. The Convention includes provisions for transfers of technology and financial resources from ICs (Industrialised Countries) to DCs (Developing Countries) to enable the latter to fulfil their (differentiated) responsibilities under the Convention. Transfers of finances are for meeting the 'agreed full incremental costs' of measures which may lead to reductions in future rates of GHG emissions.

This paper addresses the question of defining such incremental costs. It develops definitions and a LP (Linear Programming) model to arrive at a concept of 'minimal incremental costs', i.e., a notion of economic costs involved in meeting global warming responsibilities which policy makers could agree upon as the *least* that would be involved in such programs. The model assumes two alternative formulations of global warming responsibilities under future national strategies envisaged by the Framework Convention. The first specifies a time path of GHGs *emissions* in the economy as a whole. The second, supposes that such a strategy would specify a time path of GHG *intensity* in the economy (which may be a vector disaggregated by sector).

The costs considered in this paper are economic, not financial. The principal difference between such costs occurs at three levels. First, financial costs, as typically determined by an accountant, involve only actual financial expenses (on capital, labour, materials, taxes, depreciation). Economic costs, on the other hand, are 'opportunity costs', i.e., the benefits foregone by not utilizing a given resource in the best alternative use. Consider for example, an owner who manages her own retail store and pays herself no salary. Since no monetary transaction occurs, an accountant would not recognise any costs. On the other hand, for the economist there exists an opportunity cost equalling the highest salary that the owner could have earned by working elsewhere.

Further, economic costs exclude transfer payments such as taxes and subsidies, since these do not represent any direct claims on the resources of the economy. They merely represent a transfer of control over the resources from one agent to another within the economy. For example, when a firm pays taxes to the government these do not form a part of the economic costs since all that occurs is a transfer of purchasing power from the firm to the government. However, if the government were to use the funds so obtained to, say, construct a dam, then these expenditures would constitute economic costs.

Economic costs also correct for market failures — for e.g., by including externality costs, which are costs passed onto third parties not involved as producers or consumers of the good/service in question. In the case of environmental externalities experienced by the society in question, it is assumed that these externality costs refer to local, not global impacts. In other words, it is assumed that the national strategy either ensures that the global emissions profile is such that no global warming impacts are perceptible, or that all costs of adaptation or damage would be met under other regulatory arrangements or provisions.

It should be noted that the notion of economic costs includes costs on account of retraining of personnel, hiring of skilled labour (specialists), royalty payments,

administrative expenditures, etc., that might have to be undertaken as the result of a new technology that is brought into place. Additionally, a number of measures — information dissemination, infrastructure development, etc., — all of which enable and assist firms to adopt the technology in question, may also be required. For example, in order to switch from using incandescents to compact fluorescents, the entire power generation, transmission and distribution system will need to be upgraded so as to ensure the supply of electricity at a constant voltage. All such costs that represent the use of resources to facilitate the adoption of the new technology are a part of economic costs.

Techniques for computation of the elements of economic costs (and benefits) are detailed in several standard texts on cost-benefit analysis, and will not be repeated in this paper. What we attempt in this paper, assuming that individual elements of costs and benefits (including those of local environmental impacts) can be computed, is the following:

First, we furnish a definition of 'minimal incremental costs' of an abatement alternative which policy makers would generally agree on as representing the least economic costs involved. Second, we develop the specifications of a general LP (Linear Programming) model to compute the cost thus defined, over a national abatement program for a specified time-period under alternative regulatory assumptions.

Possible formulations of a national strategy to limit GHG emissions

A national strategy to limit GHG emissions may, in our judgement, take one of two forms. One, it may specify for each country (or category of countries) a path of future aggregate GHG emissions over time. Alternatively, it may specify (perhaps for each defined sector, say steel making, in given categories of countries or each country) a time path of GHG intensities of output (i.e., tonnes of GHGs emitted per tonne of steel produced). These are illustrated in Figures 1 and 2.

The shapes of the time paths depicted in each case may be explained as follows. In the case of DCs, it is unlikely that any national strategy in the foreseeable future would provide for actual reductions in GHG emissions. However, the adoption of benign technologies would, over time, tend to reduce the growth rates of GHG emissions, and at some time in the future, the aggregate GHG emissions may stabilize. On the other hand, in the absence of such a strategy, GHG emissions growth rates may be unchanged, or increase, as the economy grows and undergoes structural change biased towards energy intensive sectors. Figure 1 is thus explained.

Further, increasing use of benign technologies in the economy generally, and particularly in energy intensive sectors, would reduce the GHG intensity over time. Even in the absence of a national strategy, GHG intensity may also be expected to fall with time because of autonomous technological change, which may induce energy efficiency. These considerations help explain Figure 2.

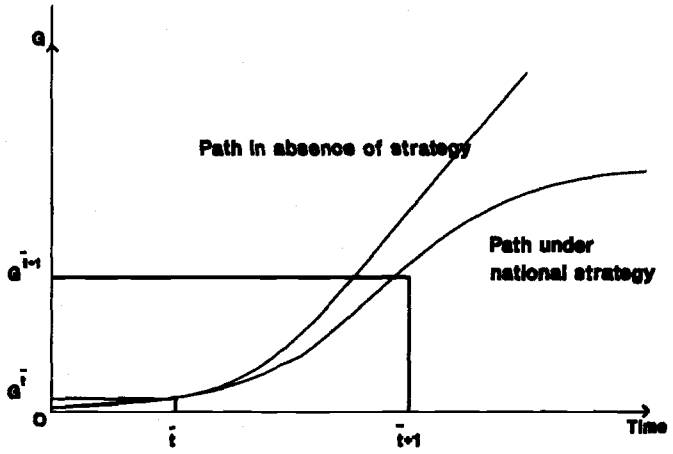

Figure 1. Timepath of GHGs emissions in an economy

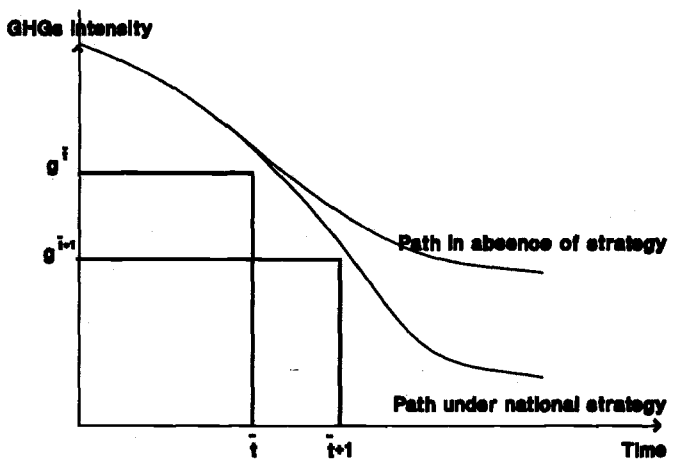

Figure 2. Time path of GHGs intensity in an economy (sector)

Costs and benefits of a given project

In this section we briefly review how net economic benefits of a given project are computed.

Figure 3 depicts a typical project profile of costs and benefits. Each project is associated with a stream of benefits and costs over time. However, these values are not strictly comparable since agents (individual, firm, society) typically have a positive time preference, i.e., they prefer to reap benefits earlier and pay costs later. Discounting reduces these values to a common denominator i.e., the present value of a stream of benefits (costs) over time. The discount rate used is the social (rather than the private) discount rate since we are considering the problem from the viewpoint of the policy analyst)[1]. The perspective is deterministic, i.e., no uncertainty attaches to any element of costs or benefits associated with the known (set of) technologies. Net economic benefits or net present value (NPV)[2] is computed as the sum of each year's benefits less costs, discounted by the discount factor. Mathematically.

$$NPV = \sum_{t=0}^{T} \frac{B_t - C_t}{(1+S)^t} \qquad (1)$$

where:

B_t : Benefits at time t
C_t : Costs at time t
S : Social discount rate.

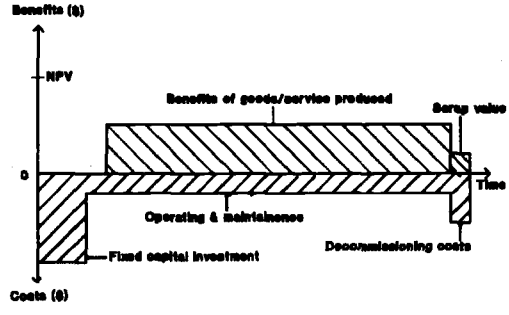

Figure 3. Profile of costs and benefits of a typical project

[1] Note that the social discount rate represents a societal choice, i.e., the respective weights attached to identical benefits (costs) occurring at different times. Techniques for computing social discount rates are also elaborated in the cost-benefit literature. They are some what controversial, but we do not go into these aspects in the present paper.

[2] The NPV is the criteria of ranking alternative projects on the basis of the respective gains in economic efficiency that they yield.

Costs and benefits of an 'interrupted' project

An abatement program may involve the interruption of an existing plant before its 'normal'[3] economic life is over, and its replacement by another plant embodying a (more) GHG benign technique. We explain below how the net benefits over the remaining normal economic life of the existing project are to be computed. Figure 4 graphically depicts the costs and benefits of project interruption.

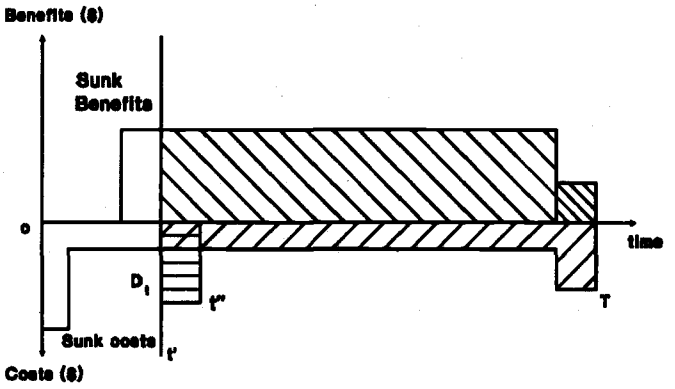

Figure 4. Computing foregone costs and benefits of project interruption

The project commenced at t = 0, and its lifetime (without interruption) would be till t = T. However, it is interrupted at t = t' and decommissioned, over the period t = t' to t''.

All 'past' benefits and costs of the project (i.e., in the period t = 0 to t') are considered 'sunk', and the foregone costs and benefits are reckoned over the period t' to T. The 'net foregone benefits' (NFB) at t' is accordingly the discounted value of all costs and benefits foregone by the interruption, less the net costs of the decommissioning operation, where all streams are discounted to the point of decommissioning. Mathematically:

$$NFB^{t'} = \sum_{t=t'}^{t=T} \frac{(B^t - C^t)}{(1+S)^{(t-t')}} - \sum_{t=t'}^{t=t''} \frac{D_t}{(1+S)^{(t-t')}} \qquad (2)$$

where D_t is the net costs of decommissioning (i.e., inclusive of any scrap value).

[3] 'Normal' in the sense of in the absence of a GHG abatement program.

Definition of 'minimal incremental cost of an abatement option'

We now employ the concepts developed above to define MIC (Minimal Incremental Costs) of an abatement option involving the interruption of an existing plant and its replacement by another (GHG benign) technique. The situation is depicted in Figure 5 (where the phasing of costs and benefits of the replacement plant are illustrated, not those of the existing plant).

The existing plant is termed A; and the replacement plant B. Both plants are assumed in this definition to yield the same level of service (e.g., MW of electricity).

The NFB of the existing project A, which is interrupted at t = t' when the replacement project B goes on stream so that there is no interruption of service, is $NFB_A^{t'}$, computed as explained in the previous section. Discounting this value to t^*, the point of time when investments in the replacement project B commence, we arrive at the NFB of project A at time t^* as:

$$NFB_A^{t^*} = \frac{NFB_A^{t'}}{(1+S)^{(t'-t^*)}} \qquad (3)$$

The NPV of project B at $t = t^*$ may be computed as described above (by using equation (1)). We now define the 'minimal incremental cost of switching from A to B at time t^*' as the difference between the net foregone benefits of the existing project A and the net present value of the replacement project B, both reckoned at the time when investment in the replacement project commences. That is:

$$MIC_{AB}^{t^*} = [NFB_A^{t^*} - NPV_B^{t^*}] \qquad (4)$$

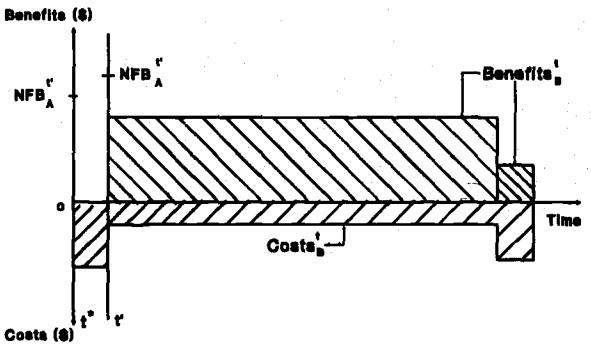

Figure 5. Costs and benefits of a replacement project

From project level to program minimal incremental costs

An abatement program under a national strategy to limit GHG emissions will, in the case of a diversified economy, involve a large number of options. While one may work out the MICs of particular abatement options, an important policy question is how to choose a least cost set of abatement options over a planning period, given two types of constraints. First, the economy should adhere, in each period, to the GHG (emissions or intensities) path specified under the national strategy. Second, that capacity in each sector of the economy at the following period is known or determined exogenously in the current period.

A detailed LP (Linear Programming) model is set out in the Appendix to both define and determine the minimal incremental costs of such a program. The main features of the model are briefly explained below.

The policy objective is assumed to be the minimization of the total economic costs of adhering to the abatement path at each planning period[4]. This is in keeping with the provisions of the Convention that any abatement measures undertaken by the DCs are contingent upon the transfer of finances (and technology) from the ICs.

The planning horizon is one period, since it is assumed that future capacities in each sector are known only up to one period in advance. Additionally, the set of available techniques is fixed only for one period in the future. The economy adheres to the specification of GHG emissions (or intensities) at the beginning and end of the period. There is a (large) discrete set of techniques, which may be embodied in current and future plans. An abatement option consists of a switch from an existing plant to another employing a (more) GHG benign technique. However, the set of pairs of such technique switches are restricted to those in the same sector. For example, an electric thermal power plant may be replaced by another electric power plant employing a more GHG benign technique, but not by say, an aluminium smelter.

Apart from switches in technique involving the same levels of service, the economy may make fresh investments (retirements) in each technique, in keeping with its growth/economic structure objectives, detailed in the set of sectoral capacities at the next period.

Minimal incremental costs are involved in each abatement technique, and there are net benefits (net foregone benefits) in each case of fresh investment (retirement). Expressed as costs (i.e. net benefits are negative costs), these are aggregated into the total costs of the abatement program.[5] A LP model is then specified, minimizing these total costs, subject to the sectoral capacities and the GHG emissions (intensities) stipulated in the national strategy in the next period in each case.

A numerical solution of this LP model may be obtained by standard algorithms (e.g., the Simplex or Karmarkar methods). The solution will furnish the 'optimal' levels of switches of pairs of techniques, as well as the set of fresh investments (retirement) in

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[4] One may suppose as an alternative, that the policy objective could be to minimize the sum of the minimal incremental costs of individual options. As a planning objective for DCs this is implausible because it would not ensure that the total costs of remaining on the specified abatement path, given the society's growth objectives, are also minimized.

[5] Where negative costs (net benefits) are involved in a particular abatement option these are excluded from reckoning of total costs on the assumption that these options may be adopted anyway, i.e., even in the absence of a national strategy.

each technique for each period. These elements of the solution may be employed to determine the 'minimal'[6] incremental cost of the abatement program in each period.

Concluding comment

The present exercise is a very limited one. The definitions of 'minimal incremental costs' at both the project and program levels are rather restrictive, and are aimed at locating a datum of incremental costs which, perhaps, all analysts may agree upon as representing the minimum direct economic costs involved.

Any actual abatement option or program will doubtless involve other direct and indirect costs. For example, society at large bears economic costs in the form of welfare changes such as those due to relative price changes, changes in income distribution, resource allocation, etc. Our definition of incremental costs does not include these and other costs, such as those due to inflation, changes in the balance of payments situation, that arise out of the macro-economic ramifications of a strategy to limit GHG emissions. Such macroeconomic effects may be difficult to apportion between the abatement and growth/structural change components of the overall program. A major research challenge for the near future is to develop appropriate notions of incremental costs which take account of these elements.

[6] 'Minimal' in the sense that these are the incremental costs associated with the minimum of the total costs as determined by the LP. Moreover, they are determined on the basis of the MIC associated with each switch from technique i to j.

Appendix

In this appendix we give the detailed mathematical structure of the LP model for computing the minimal incremental costs of an abatement program which ensures that the economy remains on the strategy mandated emissions path and at the same time does not jeopardise its growth objective.

The elements of the LP model are :

(1) A discrete set of techniques :

$\{i\} = \{1,2,.....,N\}$

(2) A discrete set of time periods :

$\{t\} = \{1,2,t,.....,T\}$

(3) GHG intensity of each technique (GHGs emitted per unit of capacity, however defined e.g., MW of electricity) g_i, and without loss of generality $g_i > g_{i+1}$ for all i ; i.e., the more benign techniques are numbered higher in the series and $g_i \gtrless o$; i.e. techniques may be sources, sinks, or zero net emitters of GHGs.

(4) Capacity installed in each technique at time t :

Q_i^t, for all i

(5) Specific cost of a given change in technique at time t:

$$\mu_{ij}^t = \frac{MIC_{ij}^t}{Q_i^t} \qquad (A1)$$

where MIC_{ij}^t is the minimal incremental cost of a change in technique from i to j at time t (see main text).

The specific costs may be illustrated as shown in Figure 6.

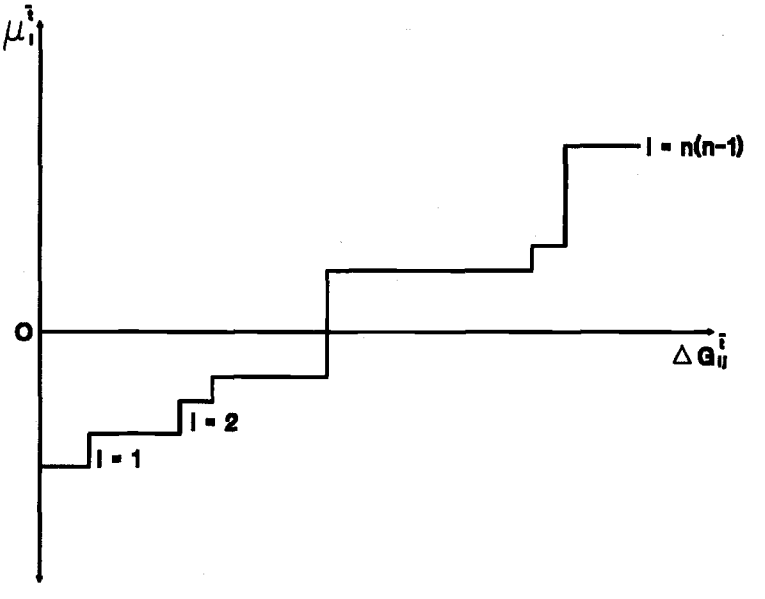

Figure 6

where:

$$\Delta G_{ij}^{\bar{t}} = (g_i - g_j)Q_i^{\bar{t}} \qquad (A2)$$

i.e., the abatement potential of the change in technique i to j at time t, and

$$\mu_l^{\bar{t}} = \mu_{ij}^{\bar{t}}; \qquad \{l\} = \{ixj \backslash l\} \qquad (A3)$$

without loss of generality,

$$\mu_l^{\bar{t}} < \mu_{l+1}^{\bar{t}}$$

(6) An allowable set of technique changes:
$\{h \times k\} \subseteq \{i \times j\}$ (A4)
$h > k, i > j$

The definition of an allowable set may be such as to allow only changes in technique within given sectors. Additionally, the allowable set may exclude abatement options which are repugnant to other policy considerations.

(7) Time paths formulated under the national strategy, which may be, either
(i) Target GHG intensity of the economy :

$$\overline{g_t} = \frac{\sum_i g_i Q_i^{\bar{t}}}{\sum_i Q_i^{\bar{t}}} \qquad (A5)$$

or

(ii) Target aggregate emissions :

$$\overline{G_t} = \sum_i g_i Q_i^{\bar{t}} \qquad (A6)$$

Model

The starting model assumption is that the strategy mandated path is adhered to at the current period t. The LP model calculates the minimal costs of a program to ensure that the economy remains on the mandated path at time t + 1, given the economy's growth objectives. These are specified as capacity levels in each sector at time t + 1. The planning objective (by assumption) is that the policy maker minimizes the net costs (maximizes net benefits) of the transition along the mandated path for each period.

Suppose the economy at t moves to t + 1, along the mandated path. Then the change in capacity of each technique j, is given by:

$$\Delta Q_j^{\bar{t}} = \sum_{i<j} q_{ij}^{\bar{t}} - \sum_{k>j} q_{jk}^{\bar{t}} + k_j^{\bar{t}} \qquad (A7)$$

where: $\Sigma_{i<j}\, q_{ij}^{\,t}$ is the aggregate of switches to j from less benign techniques;
$\Sigma_{k>j}\, q_{jk}^{\,t}$ is the aggregate of switches from j to more benign techniques; and
$k_j^{\,t}$ is the new capacity (retirement) in j at t

The incremental program cost is then given by :

$$IPC^t = \sum_j \{ \sum_{i<j} a_{ij}^t \cdot \mu_{ij}^t \cdot q_{ij}^t + \sum_{k>j} a_{jk}^t \cdot \mu_{jk}^t \cdot q_{jk}^t \} \qquad (A8)$$

where a_{ij}, etc., is a logic driven parameter, such that :
$a_{ij}^t = 1$ if $\mu_{ij}^t > o$,
$= o$ otherwise

This definition of IPC^t includes the net costs of only those switches which have positive net cost.

Now, let C_j^t be the specific net cost (positive net benefit) of new capacity in j, and r_j^t the specific net cost (positive net benefit) of retirement of j, at t in each case. The total cost of the program is then given by :

$$TC^t = \sum_j [\{\sum_{i<j} a_{ij}^t \mu_{ij}^t q_{ij}^t + \sum_{k>j} a_{jk}^t \mu_{jk}^t q_{jk}^t\} + f_j^t c_j^t k_j^t + h_j^t r_j^t k_j^t] \qquad (A9)$$

where f_j, h_j are logic driven parameters :
$f_j^t = 1$ if $k_j^t > o$,
$= o$ otherwise

$h_j^t = o$ if $k_j^t > o$,
$= 1$ otherwise.

(The total program cost nets out the net costs of technique switches having positive net benefits)

The growth constraints may be written as :

$$\sum_{j \in s} [Q_j^t + \Delta Q_j^t] \geq \overline{Q}_s^{t+1} \qquad (A10)$$

The right hand side is an exogenous specification of capacity in sector s, {s = 1, 2,--, n}, where s represents different sectors of the economy.

The policy problem is then written as :
Minimize TC^t
q_{ij}^t, q_{ik}^t, k^t
subject to
(1)

$$\sum_{j \in s} [Q_j^t + \Delta Q_j^t] \geq \overline{Q}_s^{t+1}$$

(2) Either

$$\sum_i g_i Q_i^{t+1} - \overline{G}_{t+1} \leq o$$

(aggregate GHG constraint by national strategy),
or

$$\bar{g}^{t+1} \sum_i Q_i^{t+1} - \sum_i g_i Q_i^{t+1} \leq o$$

(economy's GHG intensity constraint by national strategy).

(3) $\{hxk\} \subseteq \{ixj\}$

(only allowable set of technique changes may be considered).

The LP solution will yield the following sets : $\{q_{ij}^t\}$, $\{q_{jk}^t\}$, $\{k_j^t\}$. The first two will enable the computation of the least cost IPC^t, using equation (A8) given above.

Acknowledgement

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Technology transfer in the context of global environmental issues

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Introduction

Multilateral regulation of the global environment sought to be accomplished through Conventions and Protocols (for example, the Conventions on Climate Change and Biodiversity adopted at Rio in June 1992, and the earlier Montreal Protocol on Substances that Deplete the Ozone Layer, 1990), involves two broad classes of technology transfer issues for DCs (Developing Countries). First, technology transfers are essential in order that DCs may meet their differentiated responsibilities (not necessarily mandatory) in abating environmental damage. For example, a less GHGs (Greenhouse Gases) intensive growth path in the case of India and China may involve switches from Conventional Pulverized Coal Thermal Power technologies to more energy efficient or 'advanced' Coal Power technologies. Research and Development in respect of the latter have, for the most part, been carried out in ICs (Industrialized Countries), whose firms accordingly own the relevant IPRs (Intellectual Property Rights). Technology transfer from the owners to the relevant agents in DCs will be necessary, and the important questions here relate to the terms, depth of, who pays for, and how much, for such transfers. Second, most clearly in the case of biodiversity conservation, environmental protection (and perhaps traditional knowledge) will furnish important positive externalities to the process of technology generation (e.g. pharmaceutical products, agricultural crops) and the question is how to enable DCs to realize payments for these external benefits to technology producers. This issue is distinct from the question of paying the opportunity costs of biodiversity conservation. Each of these broad issues is spiked at the core with considerations of equity between nations, and across generations. However, this paper is not primarily an exploration of such equity issues.

In the next section we look briefly at the theoretical under-pinnings of IPRs, including a brief restatement of DCs perspectives.

Theoretical basis of IPRs[1]

The standard justification for grant of property rights over intellectual property is that such rights furnish incentives for creative work. Further, such rights are sought to be fine-tuned so that the incentives maximize the difference between the value of the resulting intellectual property and the social cost of its creation, including administration and transactions costs. In other words, the specifics of IPRs regimes are designed to realize economic efficiency. Some further questions are involved:

First, IPRs regimes are premised on the belief that prospective financial returns in fact drive private creators of intellectual property. In other words, that such private creators will have sufficient incentives only if they have the ability to capture at least

[1]The following discussion borrows from Besen and Raskind (1991).

some of the value that users place on such property: If they are unable to do so, the amount of innovative activity may be inefficient.

Second, there is the issue of whether innovative activity takes place at least social cost. This may depend upon the extent to which creators may borrow ideas or concepts from earlier work. For example, rights to 'derivative work' are typically vested in the authors under copyright law, resulting in increased costs to subsequent authors.

Third, somewhat related to the second issue, is whether the IPRs regime maintains a proper balance between creating and disseminating intellectual property. A particular incentive structure may result in resources being assigned to the creation of many new works. If however, these innovations are not widely used, the net societal benefits may be less than in the case where fewer resources are employed in creativity, but the intellectual property created is more widely disseminated. This issue focuses attention on two important questions on the appropriate scope of protection. One, what is the optimal duration of IPRs protection, for example in case of patents. Two, what is the optimal trade-off between the duration and breadth of IPRs protection.

Another way of looking at this issue is in terms of trade-offs between static and dynamic efficiency. The former would require that innovations resulting from resources invested by private agents be made widely available to all who are willing to pay the (low) marginal cost of dissemination. Accordingly, public policy should facilitate the widespread use of these assets, implying minimal property rights in them. Dynamic efficiency considerations, on the other hand would suggest that with minimal property rights, the creators may not recover their initial investment, let alone attain sufficient returns to motivate them to undertake such chancy activities in the first place. Accordingly, property rights should be stronger ('exclusive') than would be implied under static efficiency.

Formally, IPRs are domestic policy instruments, granted by national authorities. However, since innovations embodied in products (or by themselves) cross borders, the question of IPRs protection in international transfer is important. On the other hand countries have differing perspectives on the socially optimal trade-offs between duration and breadth, and indeed, on what categories of knowledge may be conferred IPRs protection. The question of harmonization of IPRs laws across countries and transboundary protection are important current issues of international political economy. A brief account of perspectives of DCs in this debate is furnished below:

Developing country perspectives[2]

We take as a model of an IPRs regime incorporating typical DCs concerns, the current Indian IPRs system. This regime diverges from typical ICs, IPRs regimes in three major aspects:

First, several categories of products and processes are excluded from IPRs protection. These include horticulture, agriculture, and food processes, and medicinal and drugs products. The reasons are that a major part of the population depends on agriculture and horticulture for its livelihood; that the purchasing power of the poor for food is limited; and because basic health care is scarce.

[2] This subsection relies on Nayyar (1992).

Second, while the system rewards innovators, it is not intended to confer monopoly rights in manufacture or imports. Accordingly, the regime permits compulsory licensing for working patents in India.

Third, the regime seeks to promote diffusion of existing technologies and innovation of technologies which create economic opportunities for a late industrializing economy. Accordingly, in several sectors (e.g., pharmaceuticals) processes may be protected while product patents are disallowed, facilitating the wider use of the products as well as local R & D in alternative manufacturing processes.

These features of the Indian IPRs regime, are at bottom, expressions of equity and (technological) development concerns. Equity within the society is sought to be realized by focusing on the need to enhance entitlements to basic needs by the poor, particularly in respect of livelihood, food and medicine. This is attempted to be accomplished through the IPRs regime itself, quite apart from any separate overall policy framework for social welfare. Accordingly, in pursuit of equity, property rights (in respect of both duration and breadth) for creators is weakened.

The second policy imperative, that of facilitating technology development, derives from the fact that comparative advantage across countries based on knowledge requires a policy framework which accelerates knowledge (and skill) acquisition. Accordingly, this policy objective justifies narrower IPRs protection, besides exclusions from patentability.

These considerations are sought by DCs to justify differentiated IPRs regimes in ICs and DCs. DCs scholars have argued that the draft agreement on IPRs at GATT (General Agreement on Tariffs and Trade) (the 'Dunkel Draft') neglects these concerns, focusing instead on the interests of ICs. Thus the proposal 'seeks to expand the scope of the IPRs system, increase the life of privileges granted or rights conferred, extend the geographical spread where the privileges or rights can be exercised, reduce the restrictions on the use of rights conferred and, above all, create an enforcement mechanism with retaliation across sectors '(Nayyar, 1992). More specifically, exclusions from patentability under the Dunkel draft would be restricted to life-forms, implying that exclusions on product patents would be disallowed. Further, the burden of proof in suits for violation would be reversed with the onus on the alleged infringer. In addition, compulsory licensing would be severely restricted, and imports deemed as working the IPRs. The period of protection would be extended (from 14 years currently in India) to 20 years. These are important deviations from, for example, current Indian patent law. Serious consequences are prognosticated: Essential technologies may become unaffordable; the emergence of domestic technological capacity may be stymied; transfers of technology may be retarded; and restrictive business practices by TNCs (Transnational Corporations) may increase. These impacts would accentuate inequalities between ICs and DCs.

Some other scholars (Sengupta, 1991), on the other hand, have argued that strengthening IPRs protection in DCs (albeit not on the lines of the Dunkel draft) would ensure continued FDI (Foreign Direct Investment). This is because of a perception in the international business community that investing in countries with weak IPRs protection is risky. Empirically however it has been noted that the laws governing foreign investment and technology transfer, as well as the general industrial environment, play a greater role in determining investment and technology flows than IPRs protection levels (Sengupta, 1991). Accordingly strengthening IPRs protection

may neither adversely affect developmental concerns, nor necessarily attract foreign investment and technology flows.

In the next two sections, we present descriptive accounts of some key IPRs instruments, as well as modes of technology transfer.

Principal types of IPRs

The two principal types of intellectual property, relevant for technology transfer in the global environmental policy context are 'patents' and 'trade secrets'.

Patents

A patent may be granted by designated public authorities in a country on 'any new and useful process, machine, manufacture, composition of matter, improvement and plant as well as to new, original and incremental design for an article of manufacture' (Chisum, 1989). In India, patents are granted under the Indian Patent Act 1970, which was based on the report of the Tek Chand/Iyengar Commission. There are important departures in the Indian statute from typical patent laws in ICs, relating largely to duration, and patentability, i.e., exactly what kinds of innovations may be patented. These differences are discussed above.

What exactly are the property rights conferred on a patent holder? In exchange for disclosure of the subject matter of the innovation to the public (which would include actual and potential rivals), the patent holder (patentee) is enabled to exclude all others from making, selling, or using the subject matter of the patent for a specified period. During this term, any use of the subject matter of the patent requires permission of the patentee, usually by means of a license involving royalty payments. The patentee can even prevent an independent subsequent inventor of the same subject matter from making, using or selling it. At the end of the period of protection, the subject matter enters the public domain, i.e., all property rights cease.

Many questions about patents are still widely debated. There is little agreement among economists on the impact of patent protection on the growth of technology (Kitch, 1986), or on the optimal (dynamically efficient) duration of patents (McFetridge and Rafiquzzaman, 1986). Further, the evidence on whether patents have helped cartelization is inconclusive (Hall, 1986).

Patents are frequently the subject of court proceedings, often by suits by patentees alleging infringement. Courts may interpret the patent claim literally, or infringement may be found if there is a 'substantial, functional identify between the patent claims and the contested item' (Besen and Raskind, 1991) i.e., the 'doctrine of equivalents'. In fact, one important legal issue is whether a patent effectively covers more than the literal disclosure in the patent application, or also includes the prospective technology that follows.

Four principal lines of defence are open to alleged infringers. The grant of the patent may itself be challenged as, first lacking the requirements of novelty and non-obviousness. Second, fraudulence by the patentee may be alleged by misrepresenting the prior art in the patent application. Third, a patent is invalid if it was patented elsewhere or described in a printed publication. Finally, the 'doctrine of misuse' relates to the use of a patent beyond its statutory scope. For example, if the license involves a tying arrangement, i.e., the licensee must purchase another product from the patentee.

Trade secrets

Trade secrets are specific commercial information. One definition (U S Uniform Trade Secrets Act, 1979) is 'information including a formula, pattern, compilation, program, device, method, technique, or process, that: (i) derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain value from its disclosure or use, and (ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy'.

Trade secrets are thus, by definition and unlike patents, not disclosed. Trade secret law only protects such information from 'improper' disclosure, but not against independent discovery or by reverse engineering (e.g., determining the chemical formula of a pharmaceutical product through chemical analysis). The incentive to create intellectual property protectible as trade secrets derives from their potential value. Trade secrets also differ from patents in respect of subject matter and duration of protection. While innovation or novelty is required of the subject matter for patent protection, commercial value is the sole criterion for protection as a trade secret. Moreover, the duration of trade secret protection is indefinite, limited only by the accident of independent discovery (or improper disclosure).

'Improper' disclosure requires a breach of duty by an employee (with access to the trade secret) to maintain secrecy. In addition, the improper act includes theft, bribery, misrepresentation, commercial espionage; in fact anything that would count as wrongful conduct even outside trade secret law. Relief against improper disclosure includes injunctions and damages.

Clearly, many categories of inventions may be eligible for protection under either patents or trade secrets law (but obviously not both). Although trade secrets law offers lesser protection, because filing a patent application involves heavy transactions costs, while the costs of preventing disclosure of a trade secret may be less, a trade secret is often the preferred course. In addition, the disclosure required of patent applications may convey sufficient useful information to potential rivals engaged in a race for related or for the next generation of innovations, and this may lead innovators to prefer trade secrets protection.

Modes of technology transfer

Technology transfer may be involved both in respect of abatement or conservation activities by DCs, as well as in realizing the rewards of granting access to environmental (e.g., genetic) resources. Technology transfer is defined as the process by which technology, knowledge and/or information developed in an organization, in a given area, or for a particular purpose, is applied and utilised in a different setting or context.

Bell (1990) distinguishes categories of transferrable technology and has identified them as three flows:

- *Flow A : Capital goods, services and design specifications*

  Technology here refers to hardware or machinery and equipment, which is acquired and brought into operational use during investment projects. Other technological and managerial services included in investment projects cover execution of planning and feasibility studies, types of design engineering, project management services, etc.

The flow of capital goods and services add to the transferee's production capacity, or in the case of equipment designs, provide domestic capital goods producers with specifications for setting up similar facilities.

- *Flow B : Skills and know-how for production*

Included in most technology transfer agreements is the flow of know-how required to operate and maintain new or improved production facilities. There are two main components in this flow:

a. 'Paper embodied technology': in the form of manuals, schedules, flow charts, including operating procedures, maintenance and repair procedures, routine quality control, and possibly procedures for marketing outputs and purchasing inputs.

b. 'People embodied technology': refers to knowledge and expertise required to carry out procedures, which in turn includes training of individuals in requisite skills, or in dealing with situations not covered in manuals and routines. This flow (which includes know-how and expertise) also adds to the production capabilities of the transferee.

Although Flow A and Flow B add to the production capacity of the transferee, they do not contribute substantially to his 'technological capacity'. Neither do the transfer of capital goods or of know-how (which aid in production) add to the expertise and experience required to change, adapt and develop the product or process in the future. The prospects of subsequent improvements are neglected in Flow A or Flow B.

- *Flow C : Knowledge and expertise for generating and managing technical change (**Know-why**)*

Like Flow B, it also consists mainly of information and people embodied knowledge and expertise. It differs from Flow B, in that it is concerned with changing technical systems. There is obviously some overlap between Flow B and Flow C.

The depth of knowledge and information about the technology in Flow C would be greater than that required for routine operation and maintenance. The other (and crucial) component is the expertise required to undertake various engineering design studies, or the evaluation of alternative plans and designs, or the incorporation of technology in improved production systems. Through this flow, continuous technical change could be realized in existing production facilities.

The transfer of technology can occur from a supplier to a recipient by various mechanisms. The modes of technology transfer may be classified as commercial or non-commercial. Commercial transfers are contracted primarily through markets, and non commercial transfers occur primarily through non-market institutions.

The principal commercial methods of transfer are:

(1) Direct foreign investment in a host country subsidiary or a joint venture
(2) Licensing of intellectual property rights, usually on royalty payments
(3) Technical assistance
(4) Sale, importation, installation, and servicing of machinery and other capital goods; and

(5) Franchising of consumer goods and services

Some of the non-commercial methods of technology transfer are:
(1) Advisory groups
(2) Personnel exchanges
(3) Information dissemination
(4) Education

It must be noted though that successful transfers are usually a combination of several/(all) of these mechanisms. The effectiveness of transfer is a function of the stage of technological development, characteristics of end users, its potential for absorption within the recipient country, besides other factors. Two principal commercial modes of technology transfer are discussed below in more detail.

Foreign Direct Investment

Technology transfer is often a component of foreign direct investment (FDI), although each may also stand alone. The flow of technology to DCs has frequently constituted a part of foreign direct investment, typically by large TNCs (Transnational Corporations).

Technology transfers between affiliates constitute a significant share of such transactions. Transfers involving the parent firm and their branches, or wholly (or majority) owned subsidiaries are usually done informally, and do not include formal agreement(s). In contrast, when the foreign investment is a joint venture where the local partner is a majority owner, then a formal agreement/license is typically negotiated between the technology supplier and the recipient.

The mechanism of transfer through foreign direct investment may appeal to the supplier because he retains control and earns dividends rather than royalties. Control of the local enterprise is often comprehensive: management, operation and marketing, quality control of products. This facilitates control of the technology itself as a trade secret rather than submitting to the disclosure required by patents.

From the viewpoint of the recipient, foreign investment brings in capital in the form of foreign exchange, and the security of the foreign partner's long-term commitment. However, local innovative improvement of the imported technology may be thwarted by the supplier quite deliberately.

Licensing of intellectual property rights

Technology transfer can occur independently of foreign direct investment by means such as intellectual property licenses.

A patent license transfers to the licensee several of the exclusive rights of the patent. The license is usually obtained by the payment of lump-sum fees or royalty, although other commercial arrangements are also possible.

Such an agreement enables a foreign licenser, unwilling to risk his capital in a developing country, or uncertain of a project's profitability, or unable to invest in unfamiliar conditions, to benefit from his intellectual property holding. In countries where foreign investment is regulated and local entrepreneurship is strong, technology licensing is increasingly used. Similarly where host country foreign investment laws are restrictive, either in the form of prohibition of foreign equity participation in certain sectors of the economy, or legislation requiring a phased 'fade-out' of foreign

ownership in local subsidiaries/joint ventures, it encourages TNCs interested in penetrating these markets to opt for licensing agreements in place of foreign investment. This has been the typical experience in India till recently.

Licensing is also convenient in that it is for a finite duration. From the recipient's point of view, licensing leaves him free of control and interference. The recipient may also benefit from interaction with his own government in ensuring that the agreement is equitable. However, government interference may also result in restrictive licensing arrangements, which may not be perceived by the licensee as in his interest.

Role of Government in technology transfer

The role of the government in facilitating transfers of technology should not be underestimated. It is responsible for the economic framework of the recipient country, a factor which would influence investment decisions of TNCs. The signals government gives to industry may discourage or encourage R & D as well as influence modes and depth of technology transfer. Governments are also heavily involved in funding or organizing R & D. In India 80% of scientific R & D is in the public sector, a situation similar to that in France. In the US, Government funding accounts for 50% of the total R & D investments. Further, governments are heavily involved in setting up the IPRs framework, as well as in negotiating the international IPRs regimes.

India had earlier followed a development path of import substitution, and in an effort to substitute imported technologies, indigenous technological capacity was encouraged by a restrictive regime of technology imports. No significant relationship between protection and degree of innovation has however been observed (Sengupta 1991). Recent policy changes have significantly liberalized technology imports.

IPRs regimes may impact the BOP (Balance of Payment) situations of countries in several ways. First, a strengthening of IPRs may mean that transferees would have to pay increased royalties in foreign exchange. On the other hand a loss of IPRs earnings due to weak IPRs protection in transferees' countries could worsen a trade deficit. For example, it is claimed that the US loses 60 billion dollars a year due to IPRs 'violations' in other countries.

Government policy also affects technology transfer through regulation of foreign direct investment, in terms of restriction on import of capital goods, and control of technology licensing. For example, India had earlier insisted on a majority domestic equity share of at least 51%. If however, the transferred technology was closely held, or if the industry was a designated priority industry, or if the industry had a dominant export commitment, the foreign share could go upto 74%.

Appropriate technology

The technologies under consideration for transfer should be 'appropriate' from the viewpoint of the recipient country. Some of the considerations determining whether a technology is appropriate are first, that it conforms to the development goals of the recipient country, second that it harmonizes with its resource endowments, and third that the conditions under which the transfer occurs relate to its circumstances.

Developmental goals may relate to promotion of self reliance, removal of inequalities in income, increasing employment opportunities, etc. Resource endowments relate to availability of natural resources, manpower, managerial skills, etc. The prevailing conditions include the existing infrastructure, markets, and other institutional

structures. Appropriate technologies in this context may include those that are labour intensive, use local materials, are not capital intensive and may be operated on small scales.

Context of global environmental Agreements

In this section, we discuss technology transfer issues with particular reference to the Conventions on Climate Change and Biodiversity Conservation.

The Climate Change Convention commits DCs to three specific actions:

(a) To formulate and implement publicly notified plans for abatement and adaptation.

(c) Take action to minimize any adverse effects of abatement or adaptation measures on the economy, public health and the environment.

(c) Additionally, DCs may submit specific abatement (reduction of GHGs), projects for funding.

In these the DCs are entitled to financial resources, outside of normal developmental assistance, including for transfer of technology. The quantum of assistance is described as the 'agreed full incremental costs'. If such assistance is not forthcoming, DCs have no commitments.

Technology transfer is thus visualized in respect of both abatement and adaptation measures, and to ensure that any harmful impacts of the measures themselves are minimized. No concessional or non-commercial terms of technology transfer are envisaged; only that the financial component (in the terminology employed) shall qualify as grant. Further, no attenuation of IPRs protection of the technologies are contemplated.

Similarly, the Biodiversity Convention requires all countries, including DCs, to formulate national strategies for conservation and sustainable use of genetic resources, integration of conservation concerns in policy making; establishment of protected areas etc., to conserve biodiversity; domestic legislation for conservation, and finally, promoting public awareness of biodiversity conservation. The implementation of these commitments by DCs is, again, contingent on the developed countries meeting their own (further) commitments relating to transfer of technology and 'new and additional' financial resources for meeting the 'agreed full incremental costs' of such measures. The question of what exactly would count as full incremental costs in the context of technology transfer is obviously important.

'Technology transfer and full incremental costs'

We have noted above that commercial technology transfers may occur in a dense set of modes and their combinations, from foreign direct investment protected by trade secrets, to transfer of in-depth R & D capability ('Flow C') under patent licenses on the other. One issue in defining 'full incremental costs' is what is the 'depth' (in multiple attributes) whose licensee fees would be covered by multilateral transfers to DCs through the concerned FMS (Financial Mechanisms). ICs may be expected to support transfers through 'Flow A' regimes and/or by FDI, while simultaneously pressing for liberalized FDI regimes in GATT (General Agreement on Tariff and Trade), as well as bilaterally. DCs views may be more varied, with countries like China and India perhaps perceiving advantage in 'Flow C' types of transfers, and the use of FDI being a choice variable for national authorities, rather than the IPRs holders. Rents for IPRs licenses will depend on the precise attributes of the license, i.e., depth of technology transfer.

Clearly, what types of technologies, and what depths of technology transfer would qualify for concessional funding, are important areas of future negotiations. Some of the strategic bargaining aspects of these negotiations are as follows:

In negotiating technology transfer norms, ICs may argue (and calculate) that since 'no regret' measures are in themselves of net advantage to DCs, they should (may) adopt them anyway, without any external concessional funding for in-depth transfer of such technologies under the provisions of the Conventions.

One argument that DCs may advance involves the concept of an 'investment hurdle' or 'capital-gap'. Several no-regrets strategies are typically not adopted on a wider scale because their up-front capital costs are higher than competing technologies, even though the no-regrets strategies are more (economically) efficient. The classic example in this respect is hydro-versus-thermal power; capital shortage typically leads to relative under-investment by DCs in the former, even though it is more efficient. DCs may urge that the 'capital gap' involved in such no-regret strategies be met by grant funding, because the major decision criterion for investments in their case is initial capital costs rather than (relative) economic efficiencies of alternatives.

Where technology transfer is involved, funding this capital gap may involve royalty payments for in-depth technology transfer, instead of, or in addition to, purchase of capital equipment. This would, however, require the adoption of non-restrictive norms for technology transfers.

Accordingly, another possible stratagem for DCs is to delink questions of depth of technology transfer from whether the options are 'no-regret', or involve positive (economic) costs, i.e., the norms should apply to both categories identically. What would be the advantage to DCs? Many of the important abatement measures (i.e., in terms of scope for GHGs reductions or conservation measures for biodiversity) may, in fact, be in the latter category (e.g., switch to natural gas based power generation from coal based power generation from coal based generation). If ICs perceive that it is in their interest to persuade DCs to adopt these, they would need to concede grant funding at sufficient levels that the DCs are at least indifferent between these and the Conventional options. If DCs further insist that norms for depth of technology transfer are not restrictive, (including restricted to positive cost options), enabling them to utilize such funding for technology transfer in depth, they may still be on strong negotiating ground. The application of such non-restrictive norms to no-regrets strategies may enable DCs to employ capital gap funding for in-depth technology transfers in such cases also.

The problem of strategic bargaining to realize these and other advantages is complex. DCs are as a group, more heterogenous, including in their economic interests, than ICs. Further, they are susceptible in different degrees to bilateral inducements and pressures from powerful ICs. On the other hand, a few key DCs have the potential to collectively alter global emissions patterns significantly in a few decades, giving their possible coalition considerable synergy. Strategic bargaining aspects of these questions, thus need to be addressed carefully.

One possible response to the question of norms for technology transfer is for the FM (Financial Mechanism) to purchase the IPRs for a set of abatement (conservation) technologies outright, and place these in the public domain. In that case, any country wishing to employ these technologies may do so at any depth; without it (or the FM) paying any further licensee fees.

Would such alternative arrangements be preferable for DCs? To answer this point, one may note that the universe of possible benign technologies is extremely large. Any selection must be of a far smaller set, because of limited financial resources with the FM. Since the technologies must be voluntarily placed on offer, and the potential recipients also involved in making the choice, the question arises as to whether or not one may expect outcomes in which the most efficient (or 'state of the art') technologies would enter the public domain. The vendors would have complete information about their own technologies, while the recipients would be unable to acquire such information, till the technologies are actually disseminated. A variant of the 'market for lemons' phenomenon, well known in the economics literature may therefore emerge. That is, because of information asymmetry, only the worst of the benign technologies (which are still improvements over current practice) would be actually transferred. By this means, DCs would be able to choose only from a small set or be saddled with inferior technologies. Further, since the performance of any given technology is highly context specific, and the situations of DCs are extremely varied, there would be little assurance that a particular technology would perform as advertised in a given DC situation.

The 'market for lemons' may, of course, also arise in the alternative case of individual DCs identifying benign technologies and the associated depth of transfers. In this case, however, the choice would be from a larger set, and DCs may be better able to relate technologies to their own circumstances. The greater freedom of choice may be of advantage to DCs.

Technology transfer and the contractive framework of the Biodiversity Convention

Another set of technology transfer issues are also at the heart of the BDC (Biodiversity Convention). At its core, this Convention attempts to set up a framework by which access to genetic resources are granted (typically by DCs to ICs) in exchange for transfer of the technology embodying the genetic resource. Because it is physically impossible to deny access to the genetic pool conserved[3], the framework stipulates (in the official Indian interpretation) that disclosure of the fact of use of particular genetic resources shall be made. The parties shall conduct the exchange on 'mutually agreed terms', meaning commercial contractual agreements involving royalty payments.

In this case, since what exactly comprises 'technology transfer' remains undefined, ICs may endeavour to place the least restrictive interpretation of the term. Apart from depth of transfer, since sharing of IPRs rents are envisaged, questions about duration of transfer and geographical limits over which the licensed (transferred) rights may be exercised are important.

Serious legal issues are raised by the apparent requirement of compulsory disclosure of the source of genetic resources employed, and transferring the 'make or license' discretion from the IPR holder to the gene supplier. For one, trade secrets protection may no longer be available. For another, patent protection may significantly lose its exclusionary power. Further, the effectiveness of the new regime hinges critically on exactly what penalties follow in the event of non-disclosure. If the penalties are non existent or not severe, the regime would be ineffective.

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[3] in-situ conditions

It seems that the stipulation of mandatory technology transfer in the framework for contracts confers little negotiating advantage to DCs. The reasons for this, briefly, are as follows:

There will be a clear asymmetry of information between the gene supplier and the agent developing the biotechnology, notwithstanding the fact that supply of genetic resources is to be with the 'prior informed consent' of the supplier. The latter would, at the time of negotiations, have already completed a significant amount of research, know fairly well what it was looking for, and benefitting from the provisions of the BDC facilitating mapping and organization of genetic information, a reasonably good idea of the chances of finding it. The developing country negotiators in such contracts would have lesser information, since much of it would be a proprietry to the potential user, and would therefore have little idea of the true value of the resource.

Second, is the question whether the requirement of (compulsory) transfer of technology enhances the bargaining strength of DCs. As noted above technology transfer may occur in several varying depths. The Convention is silent on this aspects.

Suppose that disclosure of use of genetic resource is, in fact, effectively mandated. In that case, biotechnology innovators must negotiate with the gene supplier regarding sidepayments and depth of technology transfer, in return for access to the gene pool. The gene supplier may be prepared to trade-off reduced depth for increased sidepayments, but would start with the disadvantage of not knowing the gene pool's true worth. It would therefore, very likely make trade-offs along an indifference contour which at every point is below that which would be the case if it had full information. The latter, on the other hand, having revealed less than the gene pool's true worth, would also prefer to trade-off reduced depth for increased sidepayments, within the disclosed valuation of the resource, since at least part of the negotiated sidepayments may be paid by the multilateral fund. If the administrators of the fund do not intervene, the likely result is only nominal technology transfer and low level of sidepayments.

However, the administrators of the fund may seek to eliminate such free rides on its finances by the gene users. Accordingly, they may attempt to negotiate norms both for sidepayments, as well as depth of transfer (which, as pointed out above, may also be an issue in defining incremental costs). In this, developed countries would collectively reveal less than their true valuations for access to genetic resources, and may also attempt to protect gene users' rights by proposing restrictive norms for depth of technology transfer. Since DCs would not know the true valuation of the resource, and collectively have little taste for increasing depth at the expense of sidepayments on offer, the process of evolving norms may only tend to freeze the earlier outcomes.

Further, even if such norms do not emerge and all sidepayments are directly paid by gene users, since rents from can be captured equally by sale of goods involving the technology, or by licensing it, reducing the amount.

What kinds of policy responses are possible and appropriate for DCs? In negotiating protocols under the Convention, they should insist upon restricting the availability of IPRs protection to biotechnology to categories in which full disclosure of the use of genetic resources is required (e.g., patents) as opposed to trade secrets protection. Further, the grant of patent must be made conditional on the existence of a prior contract for access. This may be pursued in the GATT forums as well. Additionally, they should unilaterally incorporate this restriction on IPRs protection for biotechnology in their domestic legislation. It is only the unambiguous requirement of disclosure that will compel gene users to enter into contracts for access.

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Legal liability versus administrative regulation: the problem of institutional design in global environmental policy

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Introduction

The salient features of environmental damage are first, that they are external effects of the activities of others, and therefore a potential adversarial relationship exists between the agents responsible for the activity and the victims experiencing the externality. Second, that it is often extremely difficult, if not scientifically impossible, to categorically link a particular impact (e.g., degradation of a resource, onset of a disease) to a particular environmental cause (e.g., elevated GHGs concentrations, toxic water pollution). Further, even when damage can be definitely linked to specific environmental causes (e.g., 'signature diseases' such as mesothelioma caused by asbestos exposure), it is often quite difficult to identify which of many polluting agents bear responsibility. This is particularly true when the (variable) natural environment (e.g., 'background radiation') is itself a significant source of environmental risk.

This characterization does not deny the fact that there may indeed exist environmental damage situations in which the cause as well as the party at fault can be unambiguously identified (e.g., the large scale toxic release at Bhopal). The point is that institutional design for regulating environmental risks should concentrate on situations of risk which are spatially and temporally diffuse, both in cause and in effect, because such cases are ubiquitous.

This paper seeks to contrast two distinct regimes for regulating environmental harms. The rival regimes are, first, a legal liability system, in which agents with claims to compensation[1] for injury confront alleged injurers in (environmental) courts. Second, and alternatively, an administrative regulation regime which seeks to regulate the activities themselves by means of policy instruments, which may be fiats or incentives based. In the latter regime, compensation (or adaptation costs) to victims may be provided, relying on resources generated by the application of the regulatory instruments. However, administrative regulation may employ such revenues for other policy objectives as well, or instead. While the administrative regulation regime may involve the oversight of courts by way of review of agency action and enforcement of regulatory requirements, the principal regulatory institution is administrative in character, rather than a court. The regimes are considered to be rival in the global environmental domain by assumption, i.e. an institutional structure embodied in protocols for a given environmental problem would involve one and not both regulatory regimes. Employing both concurrently would place polluters in double jeopardy and, as a matter of judgement, would probably be unacceptable. However, this assessment is tentative and future negotiations could possibly look at various combinations of the two regimes.

This paper is structured as follows: Sections 2 and 3 respectively discuss the fundamentals of legal liability and administrative regulation regimes. Section 4 looks at externality pricing, Section 5 at behavioral norms, and Section 6 at markets for rights,

[1]We exclude from this discussion the question of criminal liability from environmental harm.

in each case, under both regimes. Section 7 reviews the international practice of legal liability, while Section 8 does the same for administrative regulation, in each case in relation to the environment. The last section discusses the feasibility of the alternative regimes for multilateral regulation of Global Warming.

Fundamentals of legal liability

Legal liability is the concern of civil disputes in courts. The defendant is liable when a court awards damages against him/her for harm or loss caused to a plaintiff. Legal scholars view liability law as pursuing three distinct objectives: compensating victims, deterring harmful actions, and spreading risk in society. Economists, by contrast, tend to analyze liability law in terms of (economic) efficiency in incentives and risk-bearing (Cooter: 1991). In liability law the term 'perfect compensation' refers to a payment to the victim which restores him to his pre-harm level of welfare. In actual liability awards, compensation may equal, be lower than, or exceed the perfect compensation level. (In the latter case, the award is said to contain a 'punitive' element). In some situations courts award an 'injunction' i.e., an order to the defendant to perform a specific act, e.g., restore the previous condition of the property of the plaintiff. The device of injunctions avoids the necessity of making a monetary determination of harm, but clearly applies to a limited set of liability situations.

Three distinct concepts of legal liability figure in law. 'Strict liability' requires the injurer to compensate the victim even if the injurer is not at fault in any moral or legal reckoning.[2] 'Negligence rules' impose a legal norm of reasonable behaviour, and injurers are liable only when they fail to comply with the norm. Finally, 'exchanges of liability rights' refers to a strategy enabling trades in such rights (in the context of a legal rule conferring such rights), as if they were property.

Legal institutions for determining legal liability are characterized by a focus on resolving individual disputes between particular parties, requiring each plaintiff to establish a reasonably clear cause and effect linkage between a defendant's activity and the plaintiff's harm.[3] The process is adversarial and the perspective is post-hoc, i.e., after the injury has occurred.

Fundamentals of administrative regulation

Administrative regulatory regimes, though backed by law, rely mainly on administrative institutions. The administrative agency typically seeks to regulate the level of activity causing environmental harm, either directly, by fiat type instruments, or indirectly, by incentive based instruments. (Net) revenues may be yielded in the application of the regulatory instruments, and may be employed in either compensating (actual or potential) victims, or as accretion to general revenues, or both. Revenues may exceed, equal, or fall short of the valuation of aggregate damage.

Three main classes of regulatory instruments which have been discussed in the literature, (and also employed in conventional environmental situations) are 'pollution taxes', 'standards', and 'tradeable permits'. Pollution taxes are levied on each unit of a

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[2]It is an established legal principle that liability can be imposed even for damage caused as a result of actions not necessarily prohibited by law. this is expanded upon below.

[3]In certain case involving significant damage, courts have shifted the burden of proof to the damage causing party.

specified pollutant discharged, thus pricing the external effect of the discharge to the polluter. Standards represent a norm of pollution emissions, (e.g., tonnes of TSPs that may be emitted by a given power plant in a year). This norm may be violated only at a cost, representing a penalty which may be an actual monetary payment, or some other (e.g., shutting down the offending plant). Tradeable permits are rights to pollute (by a given agent, over a defined region in a year) assigned by, or purchased from the regulator, which may be traded in a market for such rights.

Intuitively speaking, the three classes of regulatory instruments bear correspondence with the three legal liability doctrines. Strict liability and pollution taxes both price the externality to the polluter, while negligence rules and standards both impose behavioral norms whose violation results in a penalty. On the other hand, markets for liability rights and tradeable permits, both refer to voluntary exchanges of property rights over the externality.

Comparing the institutions

In typical environmental harm situations with long periods of latency, transactions costs under legal liability regimes may be high, in relation to individual harms. Individual victims may, therefore, desist from suing, particularly if the burden of proof in such cases is on the plaintiff. While class action suits may reduce individual litigation costs, 'sufficient' evidence still needs to be adduced to prove the fact of harm in respect of each plaintiff, that the harm was due to the particular environmental externality, which in turn is attributable to the activity of the defendant. The evidentiary burden is non-trivial even in the 'clearest' of cases, and may be impossible where a cause and effect relationship cannot be scientifically established. Further, in the case of long latency periods, an identifiable, solvent defendant may not even exist, having declared bankruptcy or been long dissolved. Finally, given that liability damages are finally awarded, the defendant(s) pockets may not be deep enough, so that the plaintiffs remain (partly) uncompensated.

An administrative regulation system, on the other hand, relies on public institutions to reduce transactions costs in regulating environmental harms. Further, by exacting penalties, taxes, or collecting the proceeds of auctioned tradeable permits, at the time the activity causing harms is undertaken, it protects victims' interests from the possibility of injurers disappearing or being unable to meet liability obligations after the harm is manifest.

In addition, administrative regimes furnish an important source of flexibility in public policy. Since penalties etc., are not linked directly to harms, the revenues may be employed for policies which maximize societal welfare, rather than to simply compensate the specific harms. This may be especially relevant where victims are hard to identify, e.g., where lung cancer is contracted by non-smokers through exposure, among other things, to cigarette smoke exhaled by smokers. A pollution tax on cigarettes may yield incremental general revenues. These may be spent, for example, on infant care schemes, or sanitation, which may mean a large reduction in statistical deaths in society. This may be preferable from a societal welfare perspective in comparison to compensating by money, a group of older lung cancer patients whose, condition is uncertainly (statistically) related to their exposure to cigarette smoke.

It may be agreed that a legal liability practice of perfect compensation eliminates incentives to potential victims to engage in averting behavior, leading to loss in efficiency. A second best solution may accordingly require liability awards to be

based on less than perfect compensation levels. This could however be perceived as unfair.

Externality pricing: strict liability and pollution taxes

Both strict liability and pollution taxes are viewed by economists as devices to achieve efficiency by internalizing to the injurer the external social costs of the polluting activity. In the case of strict liability, if perfect compensation prevails, enforcement by courts is perfect and there are no transactions costs, (aggregate) MD (Marginal Damage) to victims equals the MB (Marginal Benefit) to the injurer. In this case the activity (pollution) level is efficient, assuming further that the polluter is risk neutral and rational. The situation is depicted in Figure 1.

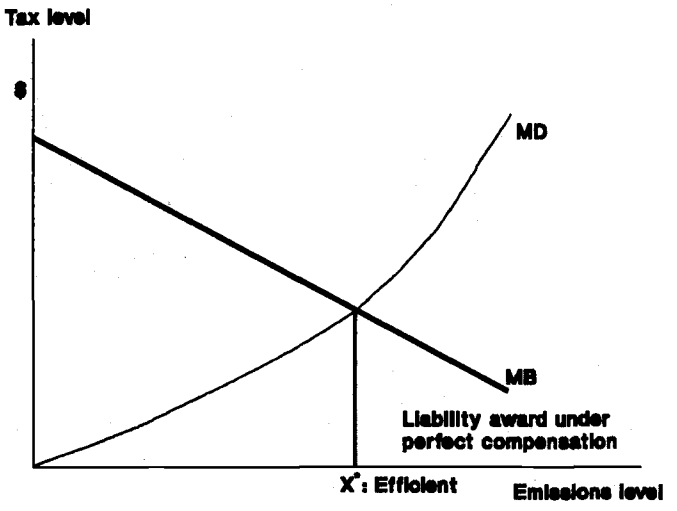

Figure 1. Efficiency in a strict liability regime

Note that compensation to victims flows directly from the liability award, and no payment in excess of the value of damage is extracted from the polluter, if compensation and enforcement are perfect.

A pollution tax regime, similarly achieves efficiency if the regulator has perfect knowledge of the MD and MB curves, and fixes the tax rate at the level where they are equal. Once again, we need to assume the absence of transactions costs and perfect enforcement, and that the polluter minimizes costs. In this case, revenues in excess of the total damage to victims is yielded, given conventional shapes of the MD & MB curves. The situation is shown in Figure 2.

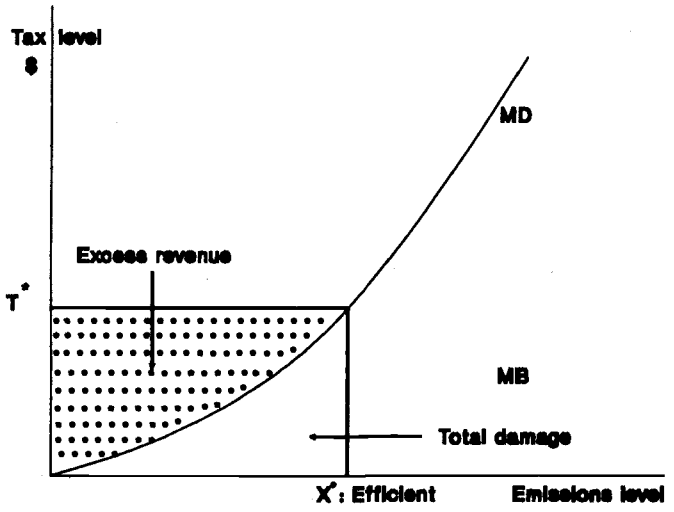

Figure 2. Efficient pollution tax

In the case of pollution taxes, compensation to victims requires a separate action of the regulator, and is not automatic. Determination of compensation amounts on the basis of valuation of actual damage may be costly.

Relaxing some assumptions

We now relax a few of the above assumptions. In the case of strict liability, actual compensation awards may be lower or higher than the efficient (perfect compensation) level. Under compensation may result from the practice of courts to disallow 'ephemeral' harms (e.g., fear of injury), or 'speculative' losses (e.g., lost economic opportunities) or where the harms are 'too remote' to have been foreseen by the injurer as a probable effect of his actions. Over compensation may result if the court neglects pre-existing risk, and attributes all of the harm to the polluting activity. In particular, courts frequently adopt a '50% rule' i.e., full compensation when the probability of a given injury from an activity exceeds 50%, and nothing if the likelihood is lower. Clearly the result will be either over compensation or under compensation. In each instance, the level of pollution will be inefficient. See Figs. 3 & 4 below:[4]

[4]It is interesting to note that in the case of undercompensation (overcompensation) the compensation paid to the marginal victim is less (greater) than the "true amount", whereas the aggregate compensation paid out may exceed (be less than) its "true" counterpart.

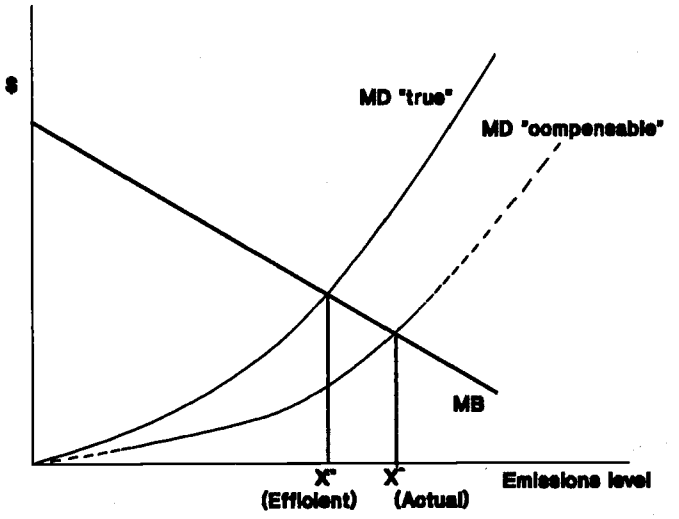

Figure 3. Effect of under compensation in a strict liability regime

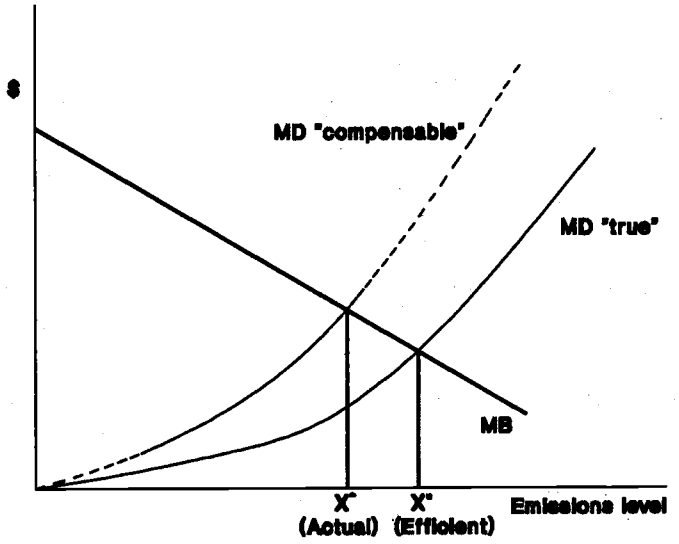

Figure 4. Effect of over compensation in a strict liability regime

The corresponding situation in the case of pollution taxes is that the regulator may not (and indeed is unlikely to) know the exact shapes of the MD and MB curves.[5] In consequence, the pollution tax may be set too high or too low, and the level of polluting activity achieved will be inefficient. These situations are shown below in Figures 5 and 6.

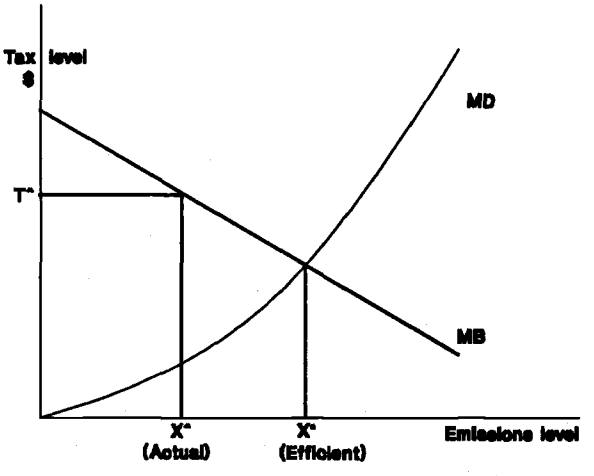

Figure 5. Effect of a pollution tax which is too high

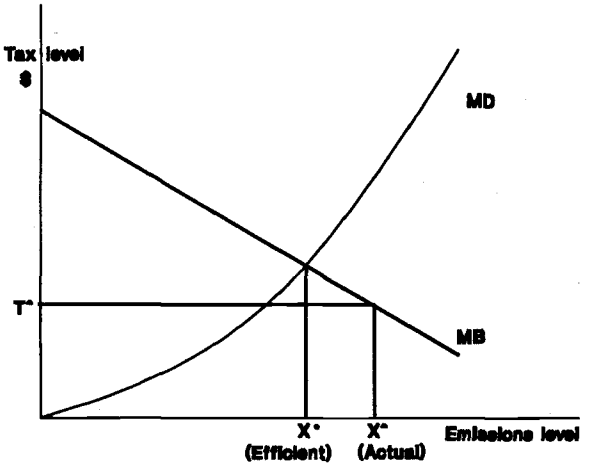

Figure 6. Effect of a pollution tax which is too low

Further, enforcement in liability trials may be imperfect, perhaps because of the difficulty of establishing causation. In such cases, while prior to trials the pollution level may be efficient, a succession of court verdicts (or one seminal verdict)

[5]Indeed, a similar situation could arise in the case of strict liability where the victim may not correctly perceive the level of harm infilicted, or be able to "prove" a level of harm which is different (perhaps higher) than the actual.

disallowing damages for a given class of harms would induce increased polluting activity.

In some situations, courts may shift the burden of proof to a class of defendants where it is difficult to establish which member is responsible for a given damage. Even so, the victim must establish a clear link between his condition and an activity. Similarly, imperfect monitoring and/or enforcement of a pollution tax may be expected to result in inefficiently high pollution levels.

Strict liability is often employed simultaneously with the doctrine of 'joint and several liability', i.e., any one member of a class of defendants is liable to the full extent of damage. The advantage is that it may ensure that a 'deep pocket' is available to compensate victims. However, the effect of joint and several liability on polluters' behaviour is uncertain. One effect could be that smaller polluters become reckless in their polluting behaviour, and at the first signs of being called to liability, retreat into bankruptcy.

Behavioral norms: negligence rules and standards

Each of these regimes impose a penalty when some norm of pollution discharge is violated. Economic efficiency, in either case, requires that the norm should be set at the level at which marginal benefits equals (aggregate) marginal damage. Further, if the polluter is rational and risk averse, deterrence requires that the penalty for discharges above the norm exceed the marginal benefit at that point. Figure 7 illustrates these principles.

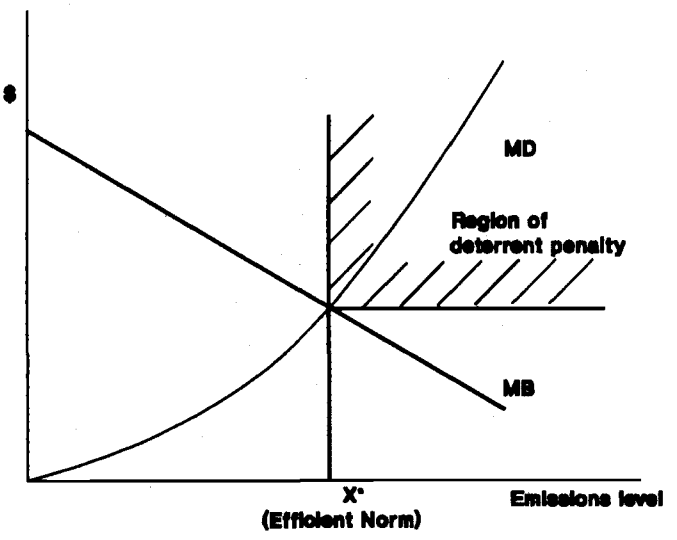

Figure 7. Efficient pollution norm and deterrent penalty

Note that as long as the emissions norm is adhered to, no payment, either as compensation or as penalty, is due from the polluter. Accordingly, if efficient, the entire social cost, if any of pollution is borne by the victims under the normative regimes.

The trick under negligence rules as well as under standards, is of course, to determine an efficient norm. In liability regimes when a community based norm exists, courts often adopt it. As long as no externalities befall third parties (i.e., apart from the injurers and victims), such community based standards may be efficient, owing to the structure of the incentives of the actors in which the norm emerges (Cooter: 1990). Courts have formalized the notion of an efficient norm in the so called 'Hand Rule'. In effect this rule states that an act is impermissible if the benefit to the injurer from the act is less than the expected (i.e. in a statistical sense) marginal damage to the victims.

In the case of administrative regulation, attempts to determine the normative standard by reference to the locations of marginal cost and marginal damage curves, are likely to fail, owing to the rather intensive nature of the information required on the part of the regulator.

Relaxing some assumptions

If the probability of enforcement is too low, a rational injurer may violate a pollution norm, under both legal liability and administrative regulation regimes. Enforcement may be imperfect in the case of a legal liability regime if the victims are unaware of the injury, unable to prove its occurrence, unable to prove who caused it, or unable to prove that the negligence standard was violated. Enforcement may be imperfect in administrative regulation if monitoring is ineffective or expensive.

In either regime, the extent of compliance may be increased if the penalty for violation of the norm includes an element of punishment. This is calculated by imposing a penalty at least (1/p) times the perfectly compensatory level, where p is the (subjective, Bayesian) probability of enforcement, whether as liability award, or as administratively imposed penalty. Suppose, on the other hand, the norm and/or penalties are not sharp but fuzzy. In this case, under either regime, one may expect that if polluters are better organized and have greater resources than potential victims, considerable effort involving transactions costs would be expended by the polluters to ensure that quantitative interpretations of the standard or penalty are liberal.[6] Clearly, there is scope for rent-seeking by the regulator (legal or administrative) when the statute possesses this feature.

'Exchanges in rights': markets for liability rights and tradeable permits

In a legal liability regime, liability rights may be viewed as property, and a legal framework for voluntary exchanges in such rights creates a market in liability rights. In such a framework, a victim may be said to possess a liability right, and if he sells the right and suffers harm, the injurer owes damages to whoever owns the liability right at that time.

Similarly, an administrative policy instrument for pollution regulation is the 'tradeable permit', in which an initial assignment of pollution rights (by auction, political largesse, or howsoever) may be traded in a market for such rights. The tradeable permits assigned must sum to the aggregate pollution emissions envisaged.

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[6]In the context of global environmental issues, it is possible that reverse might also hold true in the case where the victims — represented by nation-states — are well organised. In that case, the victims might spend resources to "establish higher levels of damage than the actual.

Both regimes will achieve economic efficiency, given some assumptions. These are first that in the case of liability rights perfect compensation may be claimed, and in the case of pollution permits the aggregate quantity of emissions allowed conforms to the efficient level. Further, that the markets in such rights are competitive, there is symmetry in transactions costs (or that these are absent), and in the case of a legal liability regime, that damages are perfectly compensated by the courts. By the Coase Theorem (Coase: 1960), as long as transactions costs do not block exchange, the initial assignment of property rights is irrelevant from the efficiency standpoint. Thus, the fact that under a legal liability regime the traded property is the victims' (matured or potential) liability rights, while in an administrative regulation regime it is the injurers right to pollute, makes no difference to the efficiency outcome. Of course, the initial assignment of such property rights will affect the distributive consequences of regulation. Figures 8 and 9 illustrate these cases.

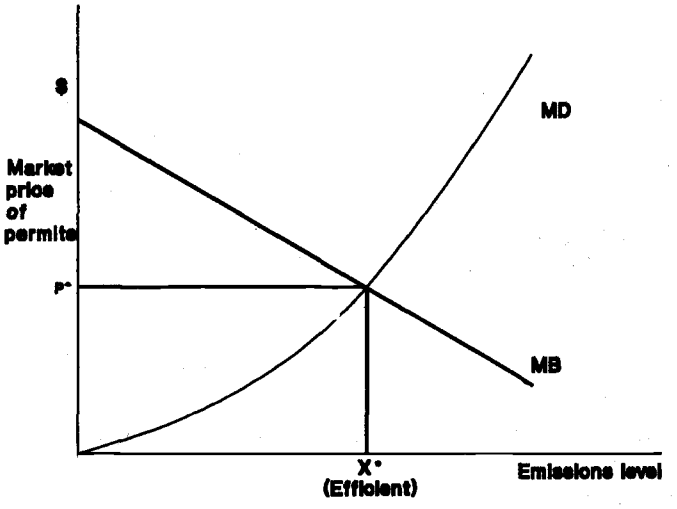

Figure 8. Efficiency under a tradeable permits regime

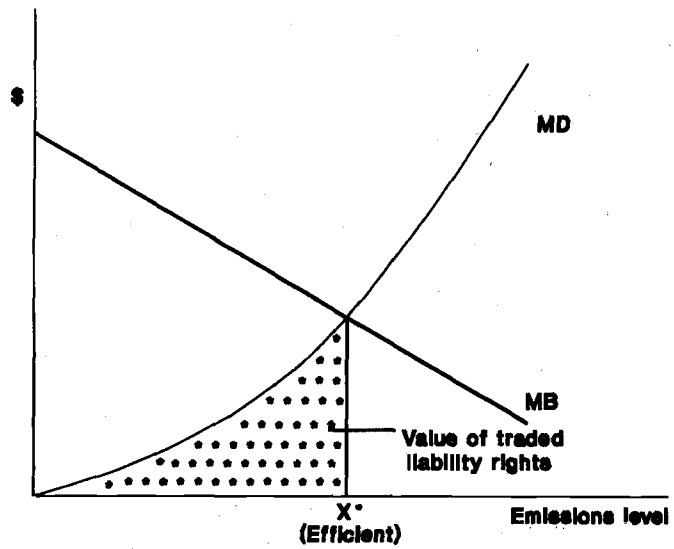

Figure 9. Efficiency under a regime of exchanges in liability rights

Relaxing some assumptions

Efficiency may result from exchanges in externality rights, but only when the markets for such rights are competitive. Causes of market failure may include market power: monopolies (monopsonies), or cartelization, as well as ineffective monitoring & enforcement. Additionally, some legal doctrines may, for example, by forbidding the plaintiff from assigning the entire value of a liability claim to his attorney as a contingency fee ('rule against champerty'), block the formation of efficient markets. Alternatively, the regulated agents may not conform to the paradigm of cost minimization, for example in the case of price regulated utilities, or nation states subject to an international regulatory regime. These sources of market failure are common to both regimes.

International practice of legal liability

The basic principle that guides much of international environmental law arises from three main cases: the Trail Smelter Arbitration, the Lac Lenoux Case and the Corfu Channel Case. Of these the Trail Smelter Case is the most important. The Arbitration grew out of air pollution from sulphur dioxide fumes from a smelter in Trail, British Columbia, owned by a Canadian corporation. The United States claimed compensation from Canada on the basis that the fumes had caused damage in the State of Washington. Canada was held responsible by the Special Arbitral Tribunal appointed for the case and was directed to pay injunctive relief and an indemnity. The main principle on which the judgement was based was that a state has a duty to protect other states against injurious acts by individuals from within its jurisdiction. The Lac Lenoux case arose out of a treaty between France and Spain of 1866, relating to the flow of boundary water which safeguarded the right of Spain to the natural flow of water into

the river Carol, an outlet of Lac Lenoux. A French proposal to use the waters for hydro generation was objected to by Spain, because it would change the natural flow. The arbitral award, in favour of France, held that the new use would still provide the previous quantity of water and therefore did not violate the treaty. The principle relevant to environmental law was that the state making the change from the norm was required to ensure that the new situation did not leave the other affected parties worse off.

In the Corfu Channel Case, the United Kingdom sought to hold Albania responsible for damage caused to warships by mines moored in the Corfu Channel in Albanian territorial waters. The International Court of Justice decided in 1949 that Albania had a responsibility to notify shipping in general of the existence of a minefield in its territorial waters and in warning the approaching British warships of the imminent danger, something that it had failed to do. In other words, nothing was done by Albania to prevent the disaster, which made it responsible. The case established a duty to inform of activities (here these were past activities) that were likely to cause serious harm to the nationals of another country.

The principle that emerges from the three cases is that states are obliged to take measures, to the extent possible, to conform to international principles and standards and to prevent or reduce injury to the environment of another state or areas beyond its jurisdiction. They are obliged to conduct activities so as not to cause injury to such states or areas. States are held responsible for the violation of this principle and of injury caused by such violation.

The causing of injury naturally leads to the question of reparation for damages suffered i.e. liability. As indicated earlier, this paper concentrates on civil aspects of liability.

The history of international liability for environmental harm and the current status of the law indicates that such liability is an extremely problematic area of international law. The Stockholm Conference in 1972 recognised it as an area that required development, but all that could be ultimately agreed upon was an undertaking to 'further develop the international law of liability and compensation'. The effort since has been to develop general principles, something that has proved extremely difficult in the absence of state practice and international adjudication. The Trail Smelter remains the main arbitral award.

The main problem of attaching liability in international law is that much of the external harm is caused by activities performed in the exercise of their legal rights by states or agents within states.

Two doctrines address the situation.

(a) The first doctrine addresses the case when rights are abused i.e. when a person makes use of his/her property rights solely to cause harm to another person. This is not usually the situation in international environmental harm, because the person causing harm is not motivated by the desire to harm persons injured beyond international frontiers.

(b) The second doctrine makes an otherwise rightful use of one's property rights wrong if it causes harm, unless the user compensates the person injured by the use.

The International Law Commission (ILC) has been studying the problem of international harm under the rubric of 'international liability for injurious consequences arising out of acts not prohibited by international law' (Henkin: 1989). It has provisionally considered whether a state's obligation in connection with transboundary

injury to other states should include a duty to prevent, to inform, to negotiate and to repair. Thus far, it has concluded, that only the failure to 'repair' the injurious consequences would result in international liability.

Apart from general principles, specific liability arrangements have been provided for in various treaty arrangements in international environmental law. These in turn have had an effect on the progressive development of these principles. An examination of some of these frameworks illustrates the type of treaties that allow for different interpretations of the liability rule and the related problems of making states agree to open themselves to claims for compensation.

Strict liability

The number of treaties/international arrangements that have provided for strict liability are extremely limited, with not much expected in the future that would pull the law in that direction. The 1972 Convention on International Liability for Damage Caused by Objects Launched into Outer Space is the only multilateral convention open to all states that imposes full liability on launching states. Other conventions that provide for 'strict liability' do so in respect of the private operator of the damage causing facility and some of these provide that the operators' state is liable on a subsidiary basis if the operator or his insurer cannot pay. An example of this is the Vienna Convention on Civil Liability for Nuclear Damage, 1963.[7]

The imposition of strict liability would therefore imply a major shift from classical principles of state responsibility under international law, under which responsibility and consequent liability for compensation arises only in the case of a violation of a rule of international law. The ILC has framed the problem in terms of primary and secondary norms. The primary norm has traditionally been the violation of a rule of international law and secondary norms include the imputation of responsibility to the state and the obligation to compensate damage. Strict liability would make the payment of reparation the primary norm.

This principle finds expression in domestic legal systems, which recognise that the activity in question need not be illegal for the injurer to be held liable. Strict liability regimes evolved to regulate activities that were considered inherently extremely dangerous. The argument was that since the operator benefited from the activity s/he should bear the cost of injury, especially since s/he was in a better place to manage the risks. In many countries this has been extended to cover many acts involving general (not necessarily ultra-hazardous) risks.

These reasons for the imposition of strict liability have been modified and translated into the international arena. Strict liability has been called for in cases of disastrous accidents involving ultra-hazardous technologies. The argument is that the problems victims would face to prove negligence would be far too great and would make compensation unlikely or meaningless. There are problems with this doctrine, evidenced by the failure of affected states to claim compensation in cases that could have involved the above principles, as in Chernobyl and Basel.

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[7]This section draws from Oscar Schachter: The Emergence of International Environmental Law, *Journal of International Affairs*, Winter 1991.

Qualified versions of strict liability

These have evolved as a consequence of governments refusing to accept strict liability formulations for most kinds of damage. The regime being developed by the ILC would have the state of origin compensate an affected state for appreciable harm caused by its (or its agents') activities. This would apply to internationally lawful activities and the harm must *in principle* be fully compensated (Barboza: 1990). The qualifications are as follows. First, reparations would be decided by negotiation between the state of origin and the affected state. Second, states are required to be guided by equity based criteria in determining the reparation. Compensation might be reduced if the nature of the activity and the circumstances of the case would mandate or imply equity through cost sharing. These special circumstances could arise when significant amounts have already been spent by the injurer on risk reduction, when damage in the affected state is less than other beneficial side effects or when states are limited in their ability to take preventive measures. In essence the ILC proposal would impose strict liability for all transboundary injury, but would leave it to the states involved to decide reparation in each individual case, on the basis of equity and balance of interests. A refusal even to negotiate would be considered a dereliction of international obligation.

The main problem with such a formulation would be the setting up of an institutional arrangement to oversee these cases. Experts consider it likely that the ILC draft articles will be adopted by the Commission as a recommended basis for either an international convention or simply to guide state practice (Schachter: 1990). It is improbable that they will become a binding treaty, but they may become a model for specialised treaty regimes applicable to well-defined activities involving a significant risk of transboundary injury.

Negligence standards

State liability under negligence standards is more closely related to classical notions of state responsibility for wrongful conduct. Certain environmental impacts that have international consequences are dealt with under different treaty arrangements. These establish rules and standards for activities that create risks of transboundary harm. Such rules and standards vary from detailed ones such as those established for nuclear plants to broad, general formulations of due diligence/due care. In these situations, a failure to comply with such rules or standards could be wrongful international conduct, with state responsibility and consequent liability arising from it.

There are two interpretations of the negligence standard formulation. The first is the obvious one that if a state is party to a convention that establishes or agrees to follow certain standards, it would be responsible and liable for damage arising out of a violation of the rule. The second is that generally adopted standards by international organizations would be a basis for liability even though the standards were not legally or otherwise binding for the violating state.

Due care

Negligence standards have been further adapted into approaches that would give effect to standards adopted by international organizations not as law but as a criteria of the due diligence or due care required of all states in regard to activities that create an appreciable risk of transborder injury (Schachter: 1990). This can be thought of as going beyond a system that would use internationally binding rules and standards.

An advantage of following a due care standard is that it focuses on the specific activity and its circumstances, while not condemning the activity. In addition, it would probably allow the activity to be balanced against foreseeable injurious circumstances. Going along the same path is a proposal to shift the burden of proof from the victim to the source of injury, something that has been established by Japanese courts in the domestic context. An additional advantage is that under due care, it is not necessary to mandate a specific standard. It is enough to prove that adequate precautions were not taken.

International legal persons

An issue that queers the pitch in international law (unlike in domestic legal systems) is the question of identifying an 'international legal person'.[8] Such an entity is capable of possessing rights and duties and has the capacity to bring certain types of cases in the international sphere. In the traditional view only sovereign states could be subjects of international law, though in practice, many other entities have at various times been recognised as legal persons of a qualified nature for specific purposes.[9] As in any legal system, not all categories of subjects of international law have identical rights.

Contemporary international law has seen a widening of the concept of international personality beyond the sovereign nation state. This has been necessitated in part by the entry into the international sphere of entities such as public international organizations, multinational corporations, international NGOs, regional organizations and movements of insurgent communities and national liberation.

The extension of legal personality to *individuals* is a further issue. The progressive internationalization of human rights and the development of a body of law around this issue has pushed the law towards increasing (albeit qualified) acceptance of the individual as an occasional subject of international law. Some multilateral institutional arrangements specifically allow individuals to bring complaints against their own governments, following the exhaustion of domestic remedies. Examples of such arrangements are found in the Optional Protocol to the International Covenant on Civil and Political Rights and in the European Convention for the Protection of Human Rights and Fundamental Freedoms. A small body of case law has developed under the latter convention.

Forums for individual redress for transfrontier environmental damage have also developed most in Europe. The emerging principle here is that in so far as states recognise an international duty to prevent or reduce transfrontier environmental damage, a case can be made for rights of redress by injured parties who are not residents or nationals of the originating or damage causing state. Several West European countries afford citizens of neighbouring states access to their courts and administrative proceedings on the same footing as citizens. Under the Nordic Convention on the Protection of the Environment of 1974, Norway, Sweden, Denmark and Finland handle national pollution discharges causing damage beyond national frontiers in the same way that they handle discharges causing local damages. In environmental suits for

[8]Also known as a subject of international law.

[9]Such entities have included public international organizations such as those in the Untied Nations system, supranational entities such as the European Community and movements of national liberation such as the African National Congress.

compensation or injunctive relief, the Nordic Convention guarantees citizens of the four countries equal access to their countries courts (World Resources 1987). In 1976, the European Court of Justice decided that within the European Community, the victims of transboundary pollution may sue either in their own national courts or in the tribunals of polluter states.

International practice of administrative regulation

There are extremely few examples of administrative regulation in the international sphere. The only international arrangements that establish regulatory regimes for environment related issues are the Convention on Long Range Transboundary Air Pollution and the Montreal Protocol on Substances that Deplete the Ozone Layer.

The former (also known as the Acid Rain Convention), signed in Geneva by 34 countries under the framework of the Economic Council for Europe was the was the first multilateral agreement on air pollution, as also the first environmental accord involving all the nations of East and West Europe and North America. The subsequent Thirty Percent Protocol to the Convention (1985) in which the signatories pledged to reduce sulphur emissions by thirty percent is one of the few instances involving multilateral acceptance of a specific quantitative environmental goal.

Problems related to increased acidity of lakes and streams were brought to the Stockholm Convention by Norway and Sweden, since these countries asserted that the problem emanated from beyond their borders. The agreement was a compromise between the insistence of Norway and Sweden on 'standstill' (emissions freezes) and 'rollback' (emissions reduction) clauses and the reluctance of West Europe's largest polluters, West Germany and the United Kingdom to commit themselves to *any* formal agreement. Norway and Sweden argued for a number of years that the benefits of abatement outweighed the costs, and finally, by the time of the Stockholm Conference on the Acidification of the Environment in 1982, most countries were convinced of the advantages of following the treaty provisions.[10] Subsequent conferences in Ottawa, Munich and Amsterdam built international consensus for concerted action and led to the Thirty Percent Protocol.

The other international agreement involving specific timetables and standards for environmental protection is the Montreal Protocol to the Vienna Convention for the Protection of the Ozone Layer. The purpose of the Protocol is to inhibit production, consumption and trade in some of the compounds that deplete stratospheric ozone. Ozone depleting compounds are divided into two groups of 'controlled substances,' Group I (certain CFCs) and Group II compounds (specific halons), each subject to different limitations. The Protocol makes a distinction between two groups of countries, the first with relatively high levels of consumption of ozone depleting substances and the second, developing countries with relatively low levels of consumption.

The principal difference between the developed and the developing countries is the timing of production and consumption limitations. From mid-1989, the developed countries have had to freeze production and consumption at 1986 levels. Group I compounds must be cut to 50 per cent of 1986 levels over the next 10 years; Groups II substances may remain at 1986 levels. The developing countries are given a 10-year grace period (beginning in 1989) during which they are free to increase production and

[10]West Germany and Canada by now were facing their own acid rain problems and had a greater interest in the successful conclusion of the treaty.

consumption within certain limits. Then, they too must cut production and consumption of Group I compounds over a further 10-year period and freeze consumption and production of Group II compounds. These obligations of developing countries are conditional on prior fulfilment of transfers of finaces and technology by industrialized countries. The Montreal Protocol can (and may already have started to) significantly inhibit the worldwide growth in the consumption of compounds that deplete stratospheric ozone around the earth.

Regulating global warming

We now briefly look at the problem of designing a multilateral regulatory framework for Climate Change.

The issue of Climate Change is characterized by first, the global, multigenerational spread of potential injurers and victims. Second, by great uncertainty in the extent, nature, and spatial and temporal distribution of the impacts. Since the implicated emissions result from major, essential economic activities: manufacturing, transport, agriculture, domestic heating, etc., significant costs are involved in any contemporary regulation of the sources of emissions. On the other hand, if emissions are unabated, actual damages may be high, possibly catastrophic, and even adaptation measures to preclude harm may involve large resources. However, great scientific uncertainty attaches to causal links between emissions and actual impacts.

The nature and choice of regime will involve a prior equity determination. There is therefore an underlying value judgement in all approaches to global environmental regulation, especially since the damages are unlikely to be symmetrical over space and time. Equity can be involved in both an initial formulation which allocates differential responsibilities, and by the choice of a particular regime/instrument. In the case of the former, equity may be determined by a tentative formulation that requires states to contribute negotiated amounts to, say, a global environment fund that would then be used to mitigate the effects of global warming, or for abatement measures. In the case of the latter, the choice of instrument will be deeply intertwined with the equity outcome or determination.

In this case, equity could be implicated in two different ways. First, there is an issue of justice or fairness (in the sense of legal torts) between those causing the damage and those who suffer from it. While in this case, the parties involved could be individuals or other entities within states, in this paper we assume that the regulating regime recognises soverign nations as parties or agents. Second, there are equity considerations between nations or groups of nations, in the sense of sharing of global resources, implying real resource flows. The structure of the regime will have to be so devised that it will affect equity at the particular level that is desired. This can be illustrated by comparing equity under strict liability and under carbon taxes.

A strict liability regime, by definition, would address only the first type of equity identified above. As pointed out in an earlier section, one of the main legal rationales for liability is to compensate victims *vis a vis* those causing the damage, i.e. to perform compensatory justice. Figure 1 showed the liability award under perfect compensation. There, the dotted area under the marginal benefit curve is the amount paid out to those suffering the damage. Note the entire remaining area under the curve remains with the producer.

Note further that in the case of a carbon tax (Figure 2), a greater portion of the excess revenue collected (the dotted area) can be used for effecting distributional

objectives, after victims suffering damage have been compensated. In the global context, therefore, a tax can be used to fulfil both equity objectives, provided the excess revenues are converted into flows to countries that are entitled to such funds and therefore is more flexible. Similarly, different equity outcomes can be realised under each of the other instruments, whether legal or administrative. We now go on to examine more specific equity implications of the rival regimes.

Consider first, the possibility of a legal liability regime, imposed through global environmental courts established by international agreement, whose awards are binding. Since the actual victims and injurers (individuals, economic agents) are likely to be numerically very large, such a regime would need to recognize sovereign states as legal representatives of the actual victims and injurers, by analogy with class action suits. A problem at the outset would be that of enforcement; given the fact that the institutional mechanism for international enforcement is poor, short of coercive, adversarial measures such as sanctions and war.

In such a regime, irrespective of the actual legal doctrine adopted (i.e., strict liability, standards, or markets for rights), states with claims for damages would first need to prove before the court that the damages are indeed attributable to Global Warming. Because of great uncertainty and complexity of climatic processes, it is unlikely that scientific standards of proof would be forthcoming. Thus, for example, desertification of a region could be claimed as resulting from Global Warming. On the other hand, in a particular instance, it may also have more proximate anthropogenic causes, e.g., deforestation, livestock grazing, etc. Science may be unable to apportion responsibility for the damage in such cases to different antecedent causes. In addition, global climate is not constant in any case, and is subject to natural viability. The question of whether a particular impact is attributable to crossing of a natural threshold by anthropogenic interventions may be hard to determine.

Suppose that in a given suit, despite these problems of proof, a court accepts the plea of a particular impact having resulted from Global Warming. Assume further that anthropogenic emissions of GHGs from different countries over time are well documented. In that case, the further question of assigning responsibility for the damage would arise, which would be fundamentally affected by the initial equity determination. This is because of the concept of 'excess emissions,' i.e., not GHGs emissions as such, but their excess over the share of global natural sinks assigned to the polluter should be the basis of apportioning responsibility. The question of equity is involved in sharing these sinks. The problem is made more complex by the fact that the capacity of the sinks is not constant, but at least upto a limit, increases with increase in emissions. Further, since different countries emit different proportions of individual GHGs species, and relative environmental impacts of different GHGs depend on the period of integration, a further equity issue is involved in choosing the integration period.

Additional problems with a legal liability regime arise from the fact that since states are considered as legal representatives of classes of agents, the long time periods involved in Global Warming may seriously undermine such representative roles. States themselves may undergo fundamental political change, including of their borders, in a few decades while the identities of polluters may be erased in the same time spans. Major evolution in 'successor state' doctrines would thus be necessary for any legal liability regime to work.

Further problems may be anticipated in applying each of the three legal liability doctrines to Global Warming regulation. Strict liability cannot be enforced by injunctions to restore the pristine condition of the damaged resource, because the impacts of Global Warming are likely to be irreversible. On the other hand, adaptation costs are likely to seriously undervalue the damage suffered. Some impacts (e.g., changes in cropping cycles) may entail lifestyle and cultural changes, and thus, be essentially uncompensable. Applying an international version of the 'joint and several' liability doctrine (together with strict liability) may be grossly iniquitous, as damages may be awarded against the most vulnerable, rather than the largest polluters. Also, as described in the previous section, precedents for the imposition of strict liability in the international sphere are few and treaty framers are unlikely to accept a formulation that would constitute a major departure from current positions in international law.

If, on the other hand, a negligence standard is adopted, the issue of emissions entitlements of different countries cannot be avoided. Unless the (aggregate) standard were fixed at a threshold only over which damages would be perceptible, this would mean that all of the costs of damage would be borne by the victims. This threshold, if it exists, is likely to be highly uncertain in location, and a globally risk averse strategy may entail too low an (aggregate) standard, meaning that polluters may encounter unduly (i.e., inefficiently) high abatement costs.[11] Negligence standards, however, score in the sense that they are where current international law doctrines and state practice seem to be at, and would therefore be more acceptable to international lawyers.

Given that large uncertainties would prevail regarding causation and in the actual Climate Change impacts in different times and on different regions, it is unlikely that markets for liability rights from Climate Change would be efficient. Further, since asymmetry of information on impacts between developed and developing countries is likely, and also because developed countries are better organized, have greater resources, and are fewer in number, cartelization of the liability rights market is likely, and thus the distributive effects may also be regressive.

A frequent criticism of liability regimes of any sort is that they often involve disproportionately high transactions costs. However, in the case of global warming, this might not be a significant issue, since the transactions costs may be small relative to the value of possible damage.

Consider now the alternative of administrative regulation of GHGs emissions by a multilateral agency under a negotiated Protocol. Carbon taxes and tradeable permits for GHGs would constitute market based instruments, while emissions standards would be a fiat based approach. In each case, the regulated agents would be the contracting states. Considerations of sovereignty would require that the regulation of domestic agents (firms, consumers) to ensure compliance with national obligations under the protocol, be left to domestic authorities.

Standard environmental economics results are that market based instruments ensure cost minimization for achieving any given environmental quality (or aggregate

[11]In the case of a regime based on standards, an interesting situation might arise if an global negligence standard nevertheless allows for serious *local* environmental impacts. For example, a state might choose to fulfil its international commitment by regulating only in a part of the country, and may leave industries in other areas to continue to pollute, with harmful local effects.

emissions).[12] This result, however, hinges critically on the assumption that the regulated agents minimize costs, and additionally, in the case of tradeable permits, that the markets for permits are competitive. Neither assumption can be reasonably considered to be valid in the Global Warming context. Sovereign states are not profit maximizing firms, and these are good (positive as well as normative) reasons why they would not minimize costs (Ghosh: 1991). Further, cartelization of tradeable permits markets (whether during initial auctions or in subsequent exchanges) is clearly feasible for reasons similar to the liability rights market. One may conclude, therefore, that without further research, it is imprudent to suppose that market based instruments would minimize (global) costs of abatement.

The focus on efficiency in the environmental (and indeed in the neoclassical) economics literature generally is based on the premise that governments have at their disposal a suite of policy instruments (direct taxes, subsidies, etc.) which enable the country to ensure that its equity objectives are met, corresponding to any level of national income (efficiency). In that case, increases in efficiency are unambiguously desirable.

In the global context, this assumption is clearly untenable because, as stated above, the choice of any regulatory regime would involve a prior determination of the equity issue. Considerations of convenience would suggest that the choice of policy instruments is restricted to those which would yield significant revenues to the regulator. This would enable funds to be kept aside for adaptation strategies or compensation, as well as for meeting the requirements of equity. These instruments are carbon taxes, and auctioned tradeable permits.

The likelihood of cartelization of the permits market may, however, result in financial resource flows from poor to rich countries, and would impede equity. On the other hand, a permits system has the advantage of ensuring a pre-determined level of aggregate emissions. This cannot be accomplished by carbon taxes, although over time, the level of aggregate emissions for a given level of tax would be fairly predictable. Carbon taxes also allow the possibility of different tax rates for different (classes of) countries, as another means for equity, although the effects of such a scheme have not been analyzed in the literature.

The discussion in this section is premised on monitoring and enforcement in multilateral regulation being perfect, under both legal liability and administrative regulation. The feasibility of at least effective monitoring and enforcement is a critical question, and needs sustained research.

Combinations of different policy instruments (e.g. pollution taxes combined with standards) have also been discussed in the environmental economics literature. Quite likely, one may also devise liability regimes which combine different doctrines (e.g. strict liability with markets for rights). The present study must however terminate at this point, and these possibilities for Global Warming regulation left for future research.

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[12]If, additionally, there is no uncertainty about the locations of the MB & MD curves, each of these classes of instruments (market based as well as fiats) may be adjusted for efficiency. This requirement of information is so stringent, that at least in the global warming context it may be a non-sequitur.

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The Road from Rio

The Tata Energy Research Institute (TERI) in association with the UNDP (United Nations Development Programme) and the IDRC (International Development Research Centre), Canada conducted an international seminar in October 1992, New Delhi, shortly after the Earth Summit at Rio de Janeiro in June 1992. The theme was environment and development policy issues in Asia after Rio.

The seminar was attended by a number of eminent researchers and policymakers from around the world, who are active in the field of sustainable development. A large number of papers, including several by persons who actually negotiated the Rio agreements, on the themes of the Rio process and its outcomes, were presented. The products of the seminar include reports by three Working Groups which relate to the future course of action on sustainable development in Asia, and a *Compact on Sustainable Development Concerns in the Asian Region*, a non-official declaration of the concerns and perceptions of a number of eminent Asians. The present volume is a compilation of the papers presented at the seminar, the speeches made at the inaugural and valedictory sessions, and the outcomes. It will be of interest to researchers, policymakers, and serious activists in the movement for sustainable development.