Table of Contents

Letter from the Chair.......................................................... M. Taghi Farvar....................... 3
Editorial: Climate change— preparing for the long haul.............. Nigel Dudley....................... 6

**Section 1: Climate change and the energy crisis**

Alleviating climate change.................................................... Robert Goodland & Simon Counsell....................... 12
Nuclear power, global warming and uranium supplies............... David Fleming......................... 24
The differences between biotic and mineral resources and their implications for the conservation-climate debate............... Rolf Steppacher & Pascal van Griethuysen............ 30
Back to the energy crisis—
the need for a coherent policy towards energy systems............ Nigel Dudley....................... 38
Energy— a great deal of hot air and little sense..................... Roger Crofts......................... 43
Pollution from aircraft.......................................................... Mark Barrett......................... 51
A proposed contribution to an oil and gas strategy................... Sandra Kloff, Emmanuel Obot, Richard Steiner & Clive Wicks... 58

**Section 2: Climate change and protected areas**

Financing avoided deforestation through the Carbon Market—
a contribution to the debate.................................................. Jacques Pollini....................... 69
Protected areas, climate change and disaster mitigation........... Sue Stolton, Jonathan Randall & Nigel Dudley....................... 82
Rethinking the Landscape— does climate change herald
a new role for the UK’s national parks?........................................ Adrian Phillips....................... 92
The use of protected areas as tools to apply REDD carbon offset schemes.......................................................... Nigel Dudley....................... 99
Requiem for the Zambezi Valley?
Conservation and protected areas under climate change........... David McDermott Hughes.......... 108
Integrating climate change into the ecological
gap assessment process........................................................ Jamison Ervin....................... 116
Protected Areas and Climate Turnaround strategy (PACT)—
an insurance policy for the world’s greatest risk...................... Trevor Sandwith...................... 119

**Section 3: Climate change and livelihoods**

Managing and mitigating climate change through pastoralism.... Jonathan Davies & Michele Nori....................... 127
Climate, carbon, conservation and communities........................ Dilys Roe, Hannah Reid, Kit Vaughan, Emily Brickell & Jo Elliott....................... 142
The climate, community & biodiversity standards—a mechanism to screen for and support projects that simultaneously deliver significant benefits to the global climate, local communities and biodiversity. Joanna Durbin. 151

Adapting to climate change & why it matters for local communities and biodiversity—the case of Lake Bogoria catchment in Kenya. Musonda Mumba. 157

Section 4: Climate change and forests

Climate change, energy and biodiversity conservation in Bolivia—roles, dynamics and policy responses. Bernardo Peredo-Videa. 163
A Mediterranean response to climate change. Nora Berrahmouni. 175
Reduction of carbon emissions Brazil—the role of ARPA. Britaldo Silveira Soares Filho et al. 180

Section 5: Climate change and policy

Emerging trends and threats of climate change—implications and amelioration strategies for sustainable protected areas management in Western Africa? Edem A. Eniang. 190
Land-use in Wales under a zero-carbon strategy—the role of bioenergy and carbon sequestration. Peter Harper. 202
Time to replace globalisation with localisation. Colin Hines. 211
A green new deal. Colin Hines & Caroline Lucas. 214
Energy/climate security—2050 goal. Richard Steiner. 218
Fair trade, air miles and climate change. The Fairtrade Foundation. 221

Section 5: Book Reviews

Review of Mountain area research and management integrated approaches. David Pitt. 231
Review of Climate Change and Trade on the Road to Copenhagen. ICTSD. 232
Review of Liberalisation of trade in environmental goods for climate change mitigation: the sustainable development context. ICTSD. 234
Review of Climate Change, Technology Transfer and Intellectual Property Rights. ICTSD. 235

Section 6: CEESP News and Events

CEESP Steering Committee members and staff contact persons. 250
The differences between biotic and mineral resources and their implications for the conservation-climate debate

Rolf Steppacher and Pascal van Griethuysen

Introduction

When jointly addressing issues such as natural resources, conservation or climate change, economic questions are prevalent. The manner in which these questions are formulated, presented and organised, depends on the preconceptions of economic theory, its cultural, philosophical and methodological foundations. This is the case with natural resources: while conventional economics tries to approach natural resources through their monetary counterpart,1 ecological economics stresses the need to make the biogeochemical characteristics of these resources explicit. This allows distinguishing between the ecological and economic potential of resources, beginning with their differing capacity to meet social objectives such as economic growth and ecological sustainability. Given their radically different ecological and economic characteristics, erroneous conclusions tend to be drawn as the wide variety of natural processes is simplified down to an undifferentiated notion of natural resources. This article aims to help avoiding such erroneous approaches in the conservation-climate debate.

Résumé. Toute tentative de relier les enjeux de la conservation à la question climatique devrait partir d’une distinction préalable entre les ressources biotiques et les ressources minérales sur la base de leurs caractéristiques écologiques et économiques. Les ressources biotiques peuvent être utilisées de manière soutenable mais ne peuvent alimenter un processus de croissance économique exponentielle. Les ressources minérales (et en particulier les combustibles fossiles) permettent d’alimenter une croissance économique exponentielle, mais seulement pendant une période historiquement limitée et au prix de graves conséquences écologiques.
Distinguishing ecological characteristics of different kinds of natural resources

The main lesson of ecological economics concerns the biogeochemical nature of the economic process. It reminds us of the fact that economic processes are subject to the laws of thermodynamics, particularly the law of entropy. In accordance with this law, economic activities (production, consumption, distribution) require high quality energy-matter resources (low entropy), that are qualitatively degraded in the economic transformation process. With production and services inevitably go together low quality energy-matter waste and dissipated energy-matter (high entropy).

Such a perspective allows economic analysis to consider the biogeochemical preconditions and limitations of economic activities such as the unavoidable degradation of natural resources, the limited capacity of natural resources for renewal, and the fact that this limited capacity only relates to certain resources (so-called renewable resources). Proposing a classification that is valid both for economic and ecological analysis, Georgescu-Roegen and modern ecological economics define four analytical categories in order to take account of the potentials and limitations of natural resources: funds, services, stocks and flows. Ecological funds, built up and maintained by solar radiation are able to renew themselves and provide both ecological and economic services, as long as the conditions necessary for their renewal are met. Stocks constitute limited reservoirs of organised matter and mineralised energy resulting from biogeochemical processes on a geological and not a historical time scale, but from which it is possible to extract an energy-matter flow. This flow can thus only be exploited for a relatively short period of human history, leaving stocks depleted and the environment degraded by its dissipated energy-matter.

Distinguishing unequal economic potentials of different natural resources

Natural resources can also be distinguished according to their economic potentials, starting with their capacity to respond to the imperative of economic growth. The growth potential of living or biotic resources is naturally limited and therefore cannot fuel exponential economic growth. However, the limited capacity of biotic resources to supply economic growth is compensated by the different quality of being renewable. The lesson is: limited growth yet possible sustainability.

The case of non-renewable mineral resources is quite different. Since the time of thermo-industrial revolution mineral resources are capable of inducing a process of exponential growth: the stocked energy-matter can be used to develop machines and motors that allow an even quicker exploitation of the stocks. The process is therefore circular and cumulative. However, as the process quickens, stocks get irreversibly depleted at an increasing pace while the natural assimilation capacities are altered by the ever increasing of entropic degradation. Fuelled by a limited stock of mineral resources and taking place in a limited natural environment, such exponential economic growth is thus inexorably limited to a given historical period. The lesson is: exponential growth yet no sustainability. Table 1 illustrates the radically different potentials of biotic and mineral resources.
To distinguish between services of funds and flows of stocks makes us aware also that different natural resources have specific temporal characteristics. Given that biotic resources depend on ecological reproductive cycles, the availability of their services is subject to the natural calendar. Therefore, they do not allow for the continuous use of economic production funds (land, labour and equipment) i.e. exploit them to their full capacity. Given that economic activities in agrarian economies are diversified and organised in accordance with the cyclical rhythms of nature. On the other hand, the flow of mineral resources from stocks allows an industrial organisation of production in line, which makes it possible to use economic production funds at their full capacity. This characteristic reduces costs and makes specialisation possible, which along with the continuity of economic activity, is an essential element of industrial production.

Given their radically different ecological and economic characteristics, erroneous perceptions, illusions, economic myths and biased conclusions may occur when the wide variety of natural processes are simplified down to the undifferentiated notion of natural resources. This is the case, for instance, when attempts are made to maintain the illusion that it is possible to fuel an exponential growth process through the sustainable exploitation of biotic resources, or that the substitution of non-renewable by renewable resources would be as feasible as the inverse case. In fact, given the limited growth potential of living resources, only an exploitation of the services of these resources at a rate beyond the capacity for renewal of the funds providing them (fields, forests, lakes, seas) is able to fuel an albeit short time exponential growth process.

Given the institutionalised growth dependency of western civilisation it is not surprising therefore that nearly all technological progress over the last 150 years has been based on the substitution from renewable to

<table>
<thead>
<tr>
<th>Resources</th>
<th>Sustainable use</th>
<th>Exponential growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>biotic</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>mineral</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

Table 1. Biotic and mineral resources: radically different potentials
non-renewable resources, in industry, agriculture and services alike. In such a context, an undifferentiated concept of natural resources is highly problematical also due to the fact that the per capita consumption of mineral resources is very unequally distributed. It hides the economic privilege that goes with a high per capita consumption of mineral resources as well as the particular difficulties that are inherent in the use of biotic and other renewable resources, particularly in combination with high population growth.

Conservation of living resources and exploitation of mineral resources

Bearing in mind the radical economic and ecological differences between mineral and biotic natural resources as conditions to be considered in respect to any reasoned decision of resource utilisation, it is equally important to insist on the close links that further exist between the exploitation of mineral resources (required for the growth of the global industrial structure) and any effort in favour of the conservation of biotic resources. Given the two basic types of biotic and mineral natural resources, any realistic conservation strategy of living resources (flora and fauna) needs to consider two complementary phenomena: overexploitation and disruption.

1. Overexploitation is a complex notion due to the fact that an ecological fund consists of a constellation of biotic resources (e.g. a forest) providing multifunctional economic and ecological services. Overexploitation often means harvesting economic services (wood or minor forest products) at a rate beyond their sustainable yield. Such economic overexploitation may reduce the capacity of the fund to provide ecological services, and may lead to the weakening of the ecosystem’s resilience and capacity for renewal.

2. Disruption of the multifunctional serviceability of ecological funds may also be an indirect result of mineral resources consumption, particularly the use of fossil fuels which affect ecological funds at both local and global scale. Local waste rejection, local pollution beyond the assimilation capacity of specific local ecosystems and global CO₂ emissions beyond the assimilation capacity of the Biosphere are often as dangerous as local direct overexploitation. Climate change mainly due to excessive per capita consumption of fossil fuels in industrial societies may reduce biodiversity as much or more than local ecosystem destruction by societies not privileged to the same availability of mineral resources.

Both direct overexploitation and indirect disruption reinforce each other in a circular and cumulative causation path, and this causal interdependence is the main reason why conservation cannot only concern itself with contexts characterised by local overexploitation of biotic resources, but needs to consider environmental degradation induced by the exploitation of mineral resources as well.

Making the ecological sustainability imperative explicit

The distinction made by Georgescu-Roegen between stocks and flows, funds and services, sheds light on the notions of conservation and sustainability and their practical applications. According to this analysis, the preservationist approach to conservation corresponds to applying to biotic resources the mineral resources rationale, i.e. specified in terms of stocks...
and flows, where only the non-use will allow the maintenance of existing stocks. The contemporary approach to conservation— which focuses on the preservation of the regenerative capacities of natural ecosystems and the sustainable use of living resources— corresponds to applying to biotic resources an approach that is adapted to their specific characteristics, i.e. specified in terms of environmental funds and multifunctional services. The new concept is thus a progress. At least the days are gone when scientists and politicians from industrial countries, living mainly from mineral resources (and therefore more easily able to protect their own biotic resources), directed people living mainly from biotic resources not to use their only available resources.

However, the progress is only partial. “Modern” conservation projects are often unable to provide enough employment to compensate for the loss of activities imposed by the project. In addition, biotic resources alone cannot provide the necessary economic services to growing populations. Moreover, such projects address neither the unequal per capita consumption of mineral resources nor its global ecological consequences that both remain unresolved. Understanding the economic and ecological differences between the two categories of natural resources and their reciprocal interaction is therefore no more than a preliminary requisite for any future conservation strategy.

The terminology developed by Georgescu-Roegen allows us to address these issues by making it possible to formulate ecological sustainability imperatives in a concise and coherent manner. According to this approach, three imperatives must be guaranteed simultaneously in order to ensure that the natural environment has the capacity to sustain human activities:  

1. The preservation of the renewal capacity of multifunctional ecological funds (forests, lakes, oceans, atmosphere, the Biosphere). This is the essence of conservation.

2. A sustainable exploitation of economic services provided by the funds of biotic resources, meaning that they do not endanger the reproduction of economic and ecological services of the same funds. This is the sustainable use defined in Caring for the Earth, an understanding of natural resource use familiar to most traditional societies including the eighteenth century forestry science under the concept of sustained yield.

3. A more or less sustainable management of ecological stocks (minerals, fossil energy... The goals of conservation and sustainable use of biotic resources have little hope of being reached unless complementary and priority actions are specifically aimed at reducing the consumption of mineral resources in countries with high per capita consumption.
Climate change and the energy crisis

The issue of climate change illustrates how interdependent these three imperatives are. Induced by industrial development, human-induced climate alterations are not due to the over-exploitation of the “climatic services” but rather to anthropic disturbances in biogeochemical cycles caused by intensive exploitation of mineralised energy stocks. Social and environmental repercussions induced by this perturbation, uncertain as they may be, endanger the capacity for renewal of many ecological funds and threaten the survival of many species. In such a context, the goals of conservation and sustainable use of biotic resources have little hope of being reached unless complementary and priority actions are specifically aimed at reducing the consumption of mineral resources in countries with high per capita consumption. This interaction is recognised by the conservation community, who points out that “[a]ddressing the problem of climate change is central to efforts to conserve the integrity and diversity of nature and to ensure that natural resources are used equitably and sustainably.”

How to satisfy the needs of poor populations through the sustainable use of biotic resources?

In an effort to conciliate ecological sustainability and social equity, recent approaches to conservation advocate for the granting and reinforcing of resources rights to local populations. Apart from different institutional issues that cannot be addressed here, such approaches should not overlook the essential fact that a sustainable use of biotic resources alone can be quite insufficient to cover basic needs of a growing population, even at a low level of per capita consumption.

Development options within the limits of biotic resources are often disappointing from even essential economic and social point of views: Strategies of external aid (material and/or financial), more commercial exploitation of biotic resources, valuing traditional knowledge, tourist exploitation of “traditional” ways of life or whatever else are in reality often far more limited in economic returns than assumed. At the same time experience shows that they may create problems in terms of cultural identity, loss of autonomy and of distribution of economic return. Theoretical attempts to assign quantifiable monetary values to biological and cultural diversity (often in an effort to convince political decision-makers of the value of protecting nature) come up with virtual values and are therefore purely fictive. They can neither be invested in the formation of productive capital nor be used as payment for import or debt service.

Following industrial countries’ development path of focussing on mineral resources is an alternative that allows, for some time, an autonomous process of economic growth and the satisfaction of the basic needs of poor populations. But such a path depends not...
only on the possibility to get access to mineral resources for the most impoverished; it also requires that they be granted the right to emit into the environment the inevitable wastes generated by a process of economic growth based on mineral resources. The political and institutional requirements and implications of this alternative on a global scale are considerable. In order not to overstretch global ecological limits, any increase in consumption of mineral resources by poor populations would have to be compensated by a drastic reduction of this consumption by the wealthiest.25 The state of international negotiations on energy and climate illustrates how far away we are from such a world development.

Differentiating clearly between ecological and economic qualities (potentials and limits) of stocks and flows of mineral resources, and funds and multifunctional services of biotic resources is an imperative in order to understand the multiple double-binds and path dependencies of our actual conservation and sustainability crisis. Not to consider these differences does not only lead to erroneous perceptions or biased conclusions, it also means implicitly pursuing the economic interests of societies with the highest per capita consumption of mineral resources and actively ignoring those of less privileged societies.

Notes

1 The development of methods to define monetary counterparts to environmental goods and services is an essential element of environmental economics. The best known are the contingent valuation method, the hedonic price method and the travel cost method (Baumol & Oates, 1975; Turner et al., 1994).

2 The first law of thermodynamics, the law of conservation of energy, establishes that the quantity of energy-matter in an isolated system (with no exchange of energy-matter with its environment) remains constant; the second law, the law of qualitative degradation of energy or entropy law, states that the quality of energy-matter in all isolated systems is irreparably degraded over time. Open systems, such as economies, which exchange energy and matter with their environment, depend for the maintenance on a throughput of energy-matter that degrades in the process and leaves the environment qualitatively degraded (Georgescu-Roegen, 1971).

3 Georgescu-Roegen 1971.


5 Ecosystems such as forests and lakes but also the global ecosystem, which constitutes the Biosphere, thus enter into the category of ecological funds.

6 Fossil fuel reserves stored in the lithosphere are the typical example of ecological stocks.

7 See Georgescu-Roegen (1971:209ss) for a more detailed analysis.

8 This section is based on Steppacher & Griethuysen 2002.

9 Beyond a certain development threshold, every biotic resource stops growing, unless it has an abnormal growth pattern (of a cancerous nature), the outcome of which is most often fatal.

10 Affecting some of the limiting factors (fertilising, irrigation) is often possible, but biotic production remains subject to overall limits.

11 Such a growth potential reflects progress in know-how and techniques.

12 Georgescu-Roegen 1965.

13 Georgescu-Roegen 1965.

14 For more details see Bieri, Moser & Steppacher 1999 and Steppacher & Griethuysen 2002.

15 This situation, which corresponds to the application of the stock rationale to ecological funds, is characteristic of debtor economies trying to pay for imports or debt service by exporting agricultural resources. Advocating for a rigidly preservationist approach to conservation (where no exploitation of biotic resources is allowed), a perspective that has until recently been common among conservationists (Fisher et al., 2005), is another example of an erroneous application of a stock rationale to ecological funds.


18 Based on a different terminology and enumeration of facts, these imperatives correspond to the three priority conditions identified in the World Conservation Strategy: maintenance of essential ecological processes, preservation of genetic diversity, sustainable use of species and ecosystems (IUCN/WWF/UNEP, 1980).
19 *Caring for the Earth* defines sustainable use as “use of an organism, ecosystem or other renewable resource at a rate within its capacity for renewal.” (IUCN/UNEP/WWF, 1991:211).


21 As already recognised in the first report of the Intergovernmental Panel on Climate Change (IPCC, 1990).

22 UICN 1999:11.


24 Some of those issues are dealt with in Griethuysen et al. (2006).


**References**


