GLOBAL RESOURCE CONSUMPTION, ENVIRONMENTAL SPACE AND ECOLOGICAL STRUCTURAL CHANGE: IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT FROM THE PERSPECTIVE OF NORTH-SOUTH RELATIONS

Edgar Fürst
International Centre of Economic Policy for Sustainable Development (CINPE)
Universidad Nacional, Heredia, Costa Rica.

Abstract

This article aims at contributing to the recent debate on structural change with ecological orientation, assuming a perspective from sustainable development in the South. It starts from reviewing the issues of national innovation systems, social learning, socioeconomic equity, political institutions and the societal transformation from Fordism to an emerging post-fordist regime, within the context of current globalization. Subsequently, the environmental dimension of the global process of uneven development, i.e. the physically unsustainable scale and socially unequal appropriation of material flows, is assessed by recurring to the concept of environmental utilization space. Based on this, some ecological features of the structural change related to post-fordist globalization and its expected main consequences for the North-South-relationships are discussed. Addressing the mentioned structural change, the analysis is focused on the strategic guideline of dematerialization as the normative orientation of an overall eco-efficiency and sufficiency in economy and environment at global and national level. This leads to the assessment of the challenges for a proactive policy of an ecological structural change (ESC) in the South by means of an agenda for future research. Finally, main conclusions are derived with the purpose to clarify some elements for the debate on sustainable development, which are considered as essentials for both development theory and ecological-economic policy of structural change.

International Journal of Economic Development,
3(2), 2001.

1. Introduction

In the international debate on a comprehensive notion of economic development in the background of international trade and North-South relationships, it is well acknowledged that development requires an innovative transformation of productive and institutional forces in material, technological, socio-economic and cultural dimensions (CEPAL, 1990 for Latin America; OECD, 1992 for Europe and the industrialised North). In particular, some consensus has been reached that long-term socio-economic development is a question of social learning, historically accumulated knowledge and a particular micro-meso-macro interplay between enterprise innovation, socio-technological and cultural evolution, structural policy oriented to systemic competitiveness, and societal networks of political self-organisation/regulation (Amsden, 1989; Lundvall, 1992; Nelson, 1993; CEPAL, 1996, 1998; Messner, 1997).

The underlying processes of technical change, productivity development, institutional transformation and societal modernisation have long historical roots –in particular from the *ex-post* perspective of current globalisation (Castells, 1996-98). Its concrete patterns of structural change during different stages are being shaped by socio-economic (self-)regulation forms of governance both globally and nationally, commonly called development models. This is exemplified by the present transition from Fordism towards Post-Fordism on global, national and local-urban levels whose concrete productive and institutional features and analytical interpretations are still subject to an ongoing controversy in social science (1). In principle, this evolutionary societal perspective can be stated as valid for industrialised countries (ICs), such as the Netherlands, as well as for developing countries (DCs), such as Costa Rica, e.g. due to tourism in this country (Fürst and Hein, 2001).

It is in this context where sustainable development can and should be rethought and made more operational as a normative guide for societal transformation (Hein, 1998). Doing this, productive transformation, environmental sustainability and social equity become essentials for assessing the issue of renewed opportunities and persisting risks of the Southern societies in participating in the race towards economic globalisation, in particular in the international trade of their mostly resource-based products with the North. For these essentials, it is specially relevant to ground the

structural competitiveness of developing export economies on the ecological design and environmental supply chain management of cultivated/manufactured export products in the South, showing that the often reclaimed trade-off between competitive performance and environmental protection is reversed in a virtuous cycle, both on the level of corporations (Porter/van der Linde, 1995) and in society as a whole (Tylecote/van der Straaten, 1997). This would enable the corresponding export countries to benefit deliberately from the so-called *environmentally sound and socially fair international trade* (for two distinct perspectives, see UNCTAD, 1995, and FoEI, 1997).

However, it can be assumed that the underlying globalisation drive induces, in any case, a tendency towards a relative worldwide homogenisation of production and consumption patterns. This, in turn, can lead to considerable environmental changes in terms of increasing needs for resources (materials and energy) and services (ecological cycles, etc.) provided by nature. It is clear that the scope of this need and the corresponding impact depend on the simultaneous technological progress and structural change in the future, both being processes of uncertain evolution.

Hence, globally intensifying and/or nationally late-coming dynamics of development and modernisation can be seen as processes characterised by society-specific breakthroughs of techno-economic innovations and growing social living standards based on material and energy consumption. This implies a particular bottom level for the nature utilisation and resource consumption, but also allows for some control of the environmental load beyond this minimum resource flow by means of use efficiency and social equity. However, how high should the bottom of resource use and demand for environmental functions be? What maximum consumption of natural and environmental resources in ICs and DCs must be allowed –in the same or differentiated *threshold* levels– for feeding the "*machinery*" of economic progress associated with international competitiveness, when this is confronted with the current sustainability challenge in view of globalisation and late-coming development?

Guided by the above questions, my reflections on the issue of global resource consumption as a key dimension for sustainable development will be structured as follows:

In section 2, some basic inquiries and 'selected' areas of the debate related to the global sustainability of nature consumption are raised in such a manner that they can be assessed taking into account my arguments on the relevance of these topics for DCs. Section 3 provides a discussion of the scope, limits and theoretical/operational versions of the environmental space (ES) approach as the key concept for grasping the global resource problem. This allows for some elements to reinterpret the North-South disparity in terms of over- and under-appropriation of ES due to unequal resource flows and use intensities. Following, in section 4 some central features of the presently proposed dematerialisation and ecological structural change in the North will be analysed, focusing on their relevance (structural consequences) for the South and its integration in the world market. This leads to the assessment of the challenges for a proactive policy of ecological structural change (ESC) in the South as such, limiting this to some key components of a future research agenda (section 5). Finally, certain aspects considered as essentials for an ecological policy of structural change and sustainable development in the context discussed here will be summarised in the conclusion.

2. Main issues in the debate on sustainable resource consumption

When addressing sustainable development from a perspective of international resource flows, the central question are frequently the following: What should be –globally and country-specifically both in the North and in the South– the permissible link between income growth and material energy use in order to prevent an irreversible deterioration of the basic life-support functions of the ecosystem called "Earth"? Or could a de-linking be expected between economic growth and ecological degradation at a certain turning-point in the development process, where further income increases lead to higher environmental quality and social welfare (implying reduced poverty in DCs)? This hypothesis is the main message of the *World Development Report 1992* (IBRD, 1992), as well as of the well-known *Brundtland Report* (WCED, 1987).

From the perspective of the Word Bank, such an environmental version of *trickle-down effects of growth* in the South is heavily based on the rationale of moving towards a *greening of economic policy reforms* (Cruz et al., 1997). This means fundamentally

better resource management associated with an undistorted price and property-right setting at micro and macro levels, as well as some revised trade and incentive policies in DCs. This does not imply that these reforms involve a radical structural change in the production and consumption patterns prevailing in the North or on a global level.

This de-linking hypothesis is better known as the *Environmental Kuznets Curve (EKC),* which states that an '*inverted U*'-shaped relationship exists between environmental damages and per-capita income growth (2). This will be reviewed below in more detail with regard to its North-South implications (see section 4). The same question can be raised in terms of the currently high appreciated efficiency or productivity in resource use: Can the "*efficiency revolution*" –now exalted everywhere– really reach "*half of the nature consumption and double the welfare*" (von Weizsäcker/Lovins/Lovins, 1997), i.e. reducing the utilisation of energy and other nature-based inputs in the production and final consumption of goods and services by "*Factor 4*" (Ibid.; see also Hawken/Lovins/Lovins, 1999)? The EKC issue and the eco-efficiency postulate have to be seen against the background of the so-called '*threshold-hypothesis*' of *human scale development* (Max-Neef, 1991). According to this hypothesis, economic growth in every society correlates with an increasing quality of life. However, beyond a particular threshold further growth induces a minor change in life-quality, i.e. the phenomenon of *sufficiency* in terms of qualitative welfare will be manifest.

Other views coming from the analysis of the societal transformation on the background of changing regimes of '*global governance*' (Hein, 1999, 2000) point out features related to the ongoing transition from the *Fordist* regulation form of post-war capitalism towards a new techno-organisational and institutional regime that could be and has been called *Post-Fordism* (Amin, 1994; Jessop, 1992; Hein, 1995, 1997). It can be characterised by a variety of innovations in the direct internationalised production process (standardisation based on chips and microprocessors, labour input/time flexibilisation, '*just-in-time*' provision and marketing, strategic alliances of '*co-makership*', '*global sourcing*') and in the global *'multi-cultural* patterns of lifestyle on individual, household and societal levels. These patterns of global change are shaping the so-called *informational network society* (Castells, 1996), which is said

to be accompanied by a tendency towards new, civil society (NGO)-based institutions for worldwide regulation (Lipschutz/Mayer, 1996). As a whole, this appears to have potential for permitting a significant reduction of material intensity and, hence, less stress on the environment. Clearly, this tendency is a pure hypothesis so long as the structural and institutional features of Post-Fordist regulation are not more concrete. This still must be proven in the face of evolutionary openness and uncertainty of social history in the coming decades.

Without stretching too far into the future, it could be asked furthermore: Is it not more promising to control, right now, the "*oligarchical consumption*" (Harborth, 1991) of *global commons* by the North, recurring to explicit redistribution mechanisms related to renewed institutional regimes on the international level? These would favour the South by providing its people with the same access to the Earth's resources and equal rights for their utilisation and for the corresponding emissions derived. Thus, DC societies would have access to nature and the rights to use it as much as or even more than ICs, which have historically appropriated the services of nature in the form of a thus far disproportional environmental consumption. It is well known that the North with 20 percent of the world's population "feeds" its growth with 80 percent of the resources available globally, whereas the consumption level of the South is barely 20 percent of this natural wealth (Ibid.).

What kind of transformation of North-South relationships could be expected in order to counterbalance this other inequity on the international level? As discussed before, during and after UNCED in Rio '92, the elimination of this development disparity can by no means imply that the South should reach the same numerical consumption of the environment such as the North does currently, in order to allow the South a similar material progress and socio-economic development in the majority of its resource-rich, but marginalised-from-use economies (Bhaskar/Glyn, 1995). In view of the enormous material/energy-intensive patterns of production and consumption in the North, such an equalisation of diverging resource input standards would very probably go beyond the so-called '*carrying capacity*' of the Earth's ecosystem. That is seen less in terms of limited tangible resources but more in terms of eco-systemic productivity, resilience and stability (Perrings, 1996).

Both potential conflicts, i.e. the social inequality between ICs and DCs and the intolerable stress on ecosystem adaptability due to increasing resource use intensities (once having taken the counterbalancing technical progress on resource productivity as "*frozen*" or insufficient for reasons of precaution), constitute risks of far-reaching scope and complexity which require a new management approach not yet "*available in blueprints*".

In recent studies on sustainable societies in ICs(3), including their global interrelations with DCs, three interesting concepts and policy approaches have been brought to the *environment & development* debate, in order to assess some of the above sketched issues of 'unjust' resource consumption between North and South. These approaches include *environmental space (ES)*, *de-materialisation (DM)* and *ecological structural change (ESC)*. Until now, these issues have been treated at different levels of analytical and policy considerations, focusing on their relevance in ICs – particularly for the structural change with ecological features (Hinterberger/Luks/Stewen, 1998). Perhaps with exception of the contributions of Harborth (1991) and Bhaskar/Glyn (1995), the specific Southern perspective has still been covered quite insufficiently by the authors mentioned above (however, see Fürst (1999) for an explicit treatment from this point of view).

Therefore, this article aims to provide a more detailed insight on the North-South implications of ES, DM and ESC concepts and policy proposals related to the questions and issues such as those raised above. Its focus will be on the link between the risks of resource-based material flows at global and IC-specified levels for sustainable development on the one hand, and, on the other, the evolutionary innovation dynamics recently coined as "eco-efficiency" and even more promising as the "next industrial revolution" (Hawken/Lovins/Lovins, 1999: pp. 1, 170) on the level of global capitalism, including the affected North-South relations.

3. The environmental-space approach

After the UNCED conference in Rio 92, the policy debate on environment and development in Europe has highlighted the issues of sustainable consumption and production. In particular, the "*Sustainable Europe*" studies (see note 3), brought forward, among other campaign issues, the controversy on a resource-low lifestyle in

the North that also would address the challenge of the international injustice between ICs and DCs. This policy stance has been conceptually articulated by the approach of *environmental utilisation space*, in short, *eco-space (ES*, Opschoor, 1992, 1995; Weterings/Opschoor, 1994).

Perhaps more than any other category focused on sustainable development, the ES approach has attracted an outstanding interest (see e.g. OECD, 1995), due to its '*unique*' claim to combine biophysical economics with social equity, the latter both in intra- and intergenerational terms, with strong, not yet inquired implications for the North-South relations.

The studies mentioned above on "*Sustainable Netherlands*," "*Sustainable Germany*" and "*Sustainable Europe*," mainly carried out by the Wuppertal Institute (WI) on the basis of material flow analysis (Schmidt-Bleek, et al. 1999), define the total or resource-specific ES as the aggregated amount of primary energy, minerals, other abiotic materials, biotic resources (including forests and agricultural land), land categories (built-up, protected land, etc.), and water and air which can be utilised globally or on particular levels (continent, country, region, city), by production and end-use consumption, without violating certain threshold levels. The latter are determined on the basis of the respective standard, e.g. as a result of an international consensus on limits, such as the IPCC recommendations regarding CO_2 emissions and energy uses, or are formulated as plausible '*rules of thumb*,' such as the Factor 10 reduction goal for the majority of non-renewable resource-based materials. The threshold values –considered as first approximations to resource-specific sustainability goals for the target years 2010 and 2050 respectively– have been set in a precautious way to allow for equal access for all living people or future generations to the targeted resources within the corresponding international, continental, national or regional scope of action for coping with the allowable consumption levels (see e.g. for Europe, Spangenberg, 1996: 6).

The rationale for the specified targets lies in the well-known management rules for ecological sustainability with regard to the harvest of renewable resources, the treatment of exhaustible resources (precautious exploitation, stop or shift to renewables), the waste-absorptive capacity and the system's diverging scales for time/space between technosphere and ecosphere (see, among many

others, Pearce/Turner, 1990: 44). Mainly on the grounds of normative plausibility, these rules are transformed into the above-mentioned physical standards (based on international agreements) or into a target setting according to the "rules of thumb" for dematerialisation on the global, continental or local level (for Germany, see: BUND/MISEREOR, 1996: 56).

With respect to the globally targeted resources (e.g. atmosphere in form of CO_2 emissions), the continental or national *eco-space levels* are derived by normalising the *maximum* levels of resource consumption/use on a per-capita measure and by multiplying the latter with the population according to the corresponding scope (regional, continental, national, a group of ICs, or DCs, etc.). When these norms are compared with the effective levels of resource use in the corresponding political-territorial units, the ES concept –originally restricted to the ecological-economic performance within the politically unspecified ecosystem "*boundaries*" (Opschoor, 1992)– is now converted into an environmental proxy for social equity regarding the consumption of nature on both intrasocietal and international levels.

Thus, by providing evidence for the unequally satisfied claims of ICs and DCs on the use of global resources, the North-South disparity takes on an interesting new dimension. It can be shown in this manner that the North has over-appropriated its corresponding ES, while the South can demand more access to the Earth's resources and therefore, a more intensive material development due to the present under-appropriation of its rights. The innovative input provided by the *Friends of Earth (FoE)* studies has given this concrete equity dimension to ES, contributing in this way a meaning beyond the initial proposal based on politically defined territories and social differences (Ibid.).

In this policy-oriented perception in favour of sustainable consumption and production (see e.g. FoEI, 1997), the general key characteristics of ES can be summarised as follows:

(1) Biophysical limits:

On the basis of maximum loads resulting from the industrial metabolism-related matter-energy flows in the techno-sphere, a ceiling for the consumption of resources and environment is fixed on

the input-side of the economy considered. This normative limit finds its measurable correlatives in the biophysical indicators of:

- total material input (MI), including the mass of extracted, removed or degraded matter of terrestrial origin that does not directly enter (as monetarily accounted input) the economy, the so-called '*ecological rucksacks*' or '*hidden flows*' (4),
- material-input per production/service unit: *MIPS–material intensity per service unit* (5),
- bio-productive land/water area requirements per capita or per territorial unit - the so-called "e*cological footprints*"(6).

The first two measures of environmental load by means of resource/matter input and translocation are the outstanding results of the *approach of material balances* or *matter flow accounting* at *Wuppertal Institute* (Bringezu, 1995; Schmidt-Bleek et al., 1999). The third represents the results of recent '*ecological footprint*' *(EF)* research with its focus on Canada (see note 6).

(2) Intrasocial and international justice

With the introduction of ES per capita related to human resource consumption, a link is created between the physical throughput (scale of the economy) and the socially equitable distribution of the rights of citizens and nations regarding their access to and use of resources, both of the global commons type and of a macro-regional scope. The key indicator is then the average consumption of a territorial unit or a 'normal' consumer respectively, both in a socially normative manner. By contrasting this normative indicator with the real consumption averages or aggregates according to the resources considered respectively, the present injustice and social inefficiency of resource use can be assessed in its national and international dimensions. Thus, the differentiated consumption reduction (i.e. *de-materialisation;* see section 4) can be targeted; this implies favouring the South by means of a proportionally smaller reduction there than in the North.

(3) Intergenerational justice

The fixing of the ceiling volumes for consumption/use of natural resources and ecosystem services in (1) and the redistribution of over-used ES shares in favour of under-used ones in

(2) also involve the maintenance of the natural heritage (that is, the conservation of the basic ecosystem life-support functions) for future generations under the guiding principle of precautionary risk minimisation.

Two main implications seem to follow from the above rationale in (1)-(3). The first refers to the urgent necessity of a radical transformation of present resource-intensive patterns of production and consumption, i.e. initiating an ESC guided by the biophysical and distributive logic of ES. The second implication focuses on the reorientation towards a value-oriented rationale on normative and analytical grounds such as those outlined by *Post-Normal Science* (see O'Connor et al., 1996).

Hence, it is evident that the ES approach is by no means limited to new instruments for measuring the resource input with MIPS and EF indicators, but also involves very challenging issues of an epistemological, social and ethical character. Exactly how these challenges are being addressed by the current ES approach remains to be evaluated in the future, with particular reference to the efforts for operationalising the targets and indicators mentioned above (BUND/MISEREOR, 1996; Spangenberg et al., 1997).

4. Dematerialisation, ESC in the North and its implications for the South

4.1 The case of inequality (in space and time) and differentiation of the development process: What is really implied by the de-linking hypothesis of the Environmental Kuznets Curve (EKC)?

As pointed out above, the ES/EF approach refers to the resource utilisation related to a specific consumption profile of an average citizen or a demographic, territorial unity, both with regard to a scope that pertains to the world or to a 'national' state respectively. Assuming at the same time a given benchmarking for such an ES/EF in per-capita or per-unity terms (e.g. the average consumption on a worldwide level), the over- or under-appropriation of the corresponding resources or ecosystem services enters the nucleus of the debate on the reduction/redistribution of the total amount of nature consumption. The social challenge for the North-South relationships is almost self-evident in the above stressed

asymmetry between societies (7) with regard to the appropriation of the available ES. This inequity involves both access to and the use of natural resources (of a global scope in particular) whose rights are asymmetrically distributed between ICs and DCs. The empirical-historical dimensions of this key feature of North-South relationships have already been presented and critically assessed in several studies, in particular for the Netherlands (FoE Netherlands, 1993) and Germany (BUND/MISEREOR, 1996), among others (8).

What will be discussed here, however, is the corresponding normative strategy for shrinking the global consumption of matter and energy –in particular by an over-proportional commitment by ICs regarding such a material reduction. This is the key point of the *de-materialisation (DM)* strategy as promoted by Wuppertal Institute (WI), Rocky Mountain Institute (RMI) and other initiatives ("*Factor 10-Carnoules Declaration*", etc.). The DM commitment claims that it can achieve resource savings by Factor 2, on a global level, and by Factor 10, on the level of OECD, in the next 50 years (see, among others, Schmidt-Bleek, 1994: pp. 168 f.; Hinterberger et al., 1998: p. 84).

The differentiation of the reduction factor (2 versus10) has its rationale in the fact emphasised above that 80 percent of the natural resources pertaining to the Earth's ecosystem is consumed by 20 percent of the world's population concentrated in ICs. Thus, only the remaining 20 percent of global resources and environmental services are used by 80 percent of the world's inhabitants which are living in the Southern countries. If the per-capita average concept of ES is applied to these disproportional shares, the global resource reduction goal by 50 percent (Factor 2) implies a corresponding over-proportional savings performance of 90 percent in the North in the presence of a temporal growth of resource utilisation allowed for the South for the next 35-40 years.

It is easy to see that these factual and normative distribution structures do not adequately reflect the more complex differentiation processes in both the North and the South. The recent debate on development theory (Amsden, 1989; Hurtienne, 1989; Schurmann, 1993) has shown that these patterns of capitalist development differentiation (in particular in the periphery assumed as homogeneous by simplistic dependency approaches, etc.) have taken already place in the past in the form of varied manifestations, and

that this tendency will be further accentuated in the near future under the driving force of globalisation. Therefore, the global material flows based on nature consumption should be decomposed still more between regions and countries with very diverging development and resource-use profiles (e.g. a semi-industrialised country with high resource-use intensity, such as Brazil, versus a similar one with less dependence on natural resources, such as Singapore, etc.). Furthermore, they should be related to innovative indicators of socio-economic performance according to *'late-coming,'* recovering or blocked development processes in the South, in order to assess the surely diverging features of material flows according to the development differentiation such as has emerged contrary to the traditional dichotomy between ICs (centre) and DCs (periphery).

Both in retrospect (reviewing the historical formation) and looking forward to the present transformation of the world society, it seems promising to make evident a new, biophysically re-thought constellation of inequality in the space and time of the development process in its worldwide context. With this, some additional (or eventually basic) features of interest to understand the different accelerating or leaking forms of national capital accumulation could appear more transparent. Such elements of better understanding have been thematically used as labels –not yet elaborate enough as theoretical pieces– by recent reinterpretations of spatial and stage differences of the international socio-economic dynamics of capitalism within the analytical framework of central/peripheral Fordist forms and progressing globalisation (Lipietz, 1987, 1992; Hurtienne, 1985, 1989; Hein, 1995, 1999; Altvater/Mahnkopf, 1997).

The issue of development differentiation/inequality in space and time also has to be considered when the *Environmental Kuznets Curve (EKC)* hypothesis is analysed and reinterpreted. Following this hypothesis related to the assessment of different stages in economic development by the traditional modernisation approach (Rostow 1965), the deterioration of the ecosystem (or at least the pressure on the environment), increases with income growth and diminishes beyond a certain turning point of growth (see e.g. the catchword-creating work of Panayotou, 1993). However, its general or relative validity scope has been discussed and tested, with the main reference to pollutants (i.e. considering only some few material input flows), by empirical studies focused almost exclusively on ICs (9),

with the not too convincing exception of the *World Development Report 1992* (IBRD, 1992).

The recent EKC controversy has been up-dated mainly on econometric grounds, although recently it has been enriched by evaluations of analytically balanced arguments (see, in particular, de Bruyn, 1999; and Ekins, 2000: chapter 7). The debate is not only limited to diverging positions between neo-classical authors (Shafik/Bandyopadhay, 1992; Panayotou, 1993) and more heterodox economists (Grossman/Krueger, 1995); it is also virulent within the heterogeneous field of ecological economics (10).

It has become quite prominent by means of a programmatic statement by leading economists and natural scientists which have used different media (11)[1] to warn against a simplistic over-interpretation of the inverted-U relationship in the modernisation tradition. The statement concludes that economic growth and economic policies (e.g. free-trade-oriented liberalisation) which promote it are:

> "*not a panacea for environmental quality; indeed, … not even the main issue. What matters is the content of growth –the composition of inputs (including environmental resources) and outputs (including waste products). … Protecting the capacity of ecological systems to sustain welfare is of as much importance to poor countries as it is to those that are rich*" (Arrow et al., 1996: pp. 109-110).

Extended to the issue of increased efficiency in resource use, the turning point of the EKC can be also interpreted as a technologically feasible de-linking of economic growth from the material flows, giving way to the possibility of increased welfare with less nature consumption. The *de-linking hypothesis* has been apparently supported by findings (e.g. Jänicke et al., 1992) on the historical savings of energy and material (steel, cement, etc.) relative to production growth for 32 ICs in the West and the East between 1970 and 1987, as result of increasing use productivities (12). The corresponding interpretation as an "*environmental relief achieved by structural change*" has provoked an interesting debate on the feasibility of such a de-coupling –in a sustained manner– of the energy and material throughput from economic growth by means of higher resource efficiency and –more comprehensively– on the basis

of technological progress and industrial restructuring with ecological policy features (Binswanger, 1992, 1993; Simonis, 1994; von Weizsäcker/Lovins/Lovins, 1997; Hawken/Lovins/Lovins,1999).

Both controversies –on the significance of the EKC findings on the one hand and on the persistence of the de-linking phenomenon on the other– have reached a preliminary "*consensus result*" with a predominant reference to OECD economies. In the first case, it can be stated that there are no concise policy lessons, but only quite loose hypotheses which have not yet been validated by the present '*state of art*' of EKC research (de Bruyn/Heintz, 1999; Stern, 1998; Fürst/Orozco, 2000). Thus, it can be made evident that pressures on the environment (in most cases: emissions of CO_2, NO_2, NO_x) are inherently related to material growth (i.e. the increasing part of the 'inverted-U' shaped curve) and that environmental quality correlates with technological and structural change (decreasing part of the EKC), without implying a systematic trend to continue the described pattern historically. Rather, it is quite possible that at a certain point in time and for the subsequent period, both tendencies of increasing or decreasing environmental stress will balance themselves out or come to another return point from which the achieved environmental relief would experiment a transition to a new increasing burden due to the predominant scale effect of economic growth relative to efficiency and structural effects (i.e. assuming the case of an N-shaped curve). It seems that this was the main feature of the recent experience of most OECD countries (de Bruyn, 1999). Hence, a definitive affirmation *per se* regarding the long-term pattern of the relationship between environmental quality and income growth can hardly be stated without breaking down the underlying effects of technological progress, structural change and scale trend. Here, it is challenged that an ESC analysis has to focus on these key issues of better explanatory potentials (see Ibid.).

The same as in the case of EKC generalisations can be concluded with respect to the de-linking between matter-energy flows/resource consumption and economic progress based on material growth. In this context, there is still the case of development differentiation as a relevant explanatory factor which may deny or strengthen the validity of the EKC and the de-linking hypothesis. As stressed above, these hypotheses have been investigated so far only for the North. Of course, it would be very interesting to examine, for the South, the basic thesis simplified here that better environmental

quality can be expected when persisting economic growth has induced an historically accumulated development potential which would afford less resource-use intensity. Accordingly, the *"new or late-comers"* would have to grow in order to attain this development stage in order to reconcile material with environmental welfare (see Suri/Chapman, 1998).

An even more interesting topic is the previously hypothesised transition process towards comprehensive globalisation which itself seems to give way to the emerging tendency of transformation from *Fordist* to *Post-Fordist* regulation in the context of a new economic and societal order of world capitalism (Jessop, 1992; Lipietz, 1992; Hein, 2000). Could then an increasing life-quality be expected due to new resource-saving technologies, production/consumption patterns and lifestyles of an emerging society based on information and services (see, for example, Hawken/Lovins/Lovins, 1999)? The corresponding research efforts, both globally and nationally (differentiating between ICs and DCs as well within the latter), would have to include a scenario analysis which would go beyond the currently valid *"creative speculation"* on the environmental relief in an information society in the Post-Fordist age (see critically Binswanger, 1992; and Hein, 1999). In this focus the problem of inherently little capacity of anticipation in view of the evolutionary openness of the future would always be present.

4.2 Policy-fixed scale and equity under the precautionary principle

The DM postulate takes a pioneering stance because of its focus on scale and equity as physical and normative premises for the resource allocation process in contemporary economies. With this fixing of decision parameters outside the relative price system, the DM approach follows Daly's tradition (Daly, 1991; 1996). However, in contrast to Daly's global claim of a steady-state economy with a sharply reduced throughput, the present material flow reduction, such as represented by WI and others, is more differentiated. By distributing the long-term goal for the DM between 50% (global) and 90% (IC) with regard to the target year 2050 (BUND/MISEREOR, 1996: 80), DCs are allowed for their right of *late-coming development*, i.e. continuing their growth while increasing the consumption of nature during a certain interim period.

In terms of sustainable development strategy, the separation between scale and equity (both fixed independently from the market) on one hand, and resource allocation (guided by market signals) on other hand, are basic for shaping an ESC.

De-linking would allow for the normative discussion oriented towards fixing standards according to sound sustainability thinking. The precautious pre-determination of physical and social norms for addressing the limit challenges of the ES is quite in line with the prudent treatment of uncertainty and a lack of knowledge regarding the complex system of relationships between the economy and ecology, such as put forward in the debate by Post-Normal Science (O'Connor et al., 1996). Thus, the DM targets are based on plausibility considerations in favour of a behaviour-responsible change in the current direction of the tendency, and not on a numerically exact standard-fixing. Hence, it seems to be quite plausible to begin with a kind of '*rule of thumb*' (Factor 10) in order to transform this subsequently into a limited set of input-based indicators with complexity-reducing, direction-safe and management-simplifying properties (Spangenberg/Schmidt-Bleek,1995), e.g. the MIPS-index (Hinterberger/Schmidt-Bleek, 1999).

This ambiguous process of '*advancing on the ridge*' between a missing *ex-ante* rationale for action (in our case, the ESC that has to be initiated now and not only tomorrow) and a plausible claim to provide DM with an analytically-safe basis and the corresponding eco-policy on the grounds of Ecological Economics (see, in general, Hinterberger et al., 1998) are also valid for the ecological reforms directed to the North-South problem (see section 5). Here in particular, the present globalisation with its inherent tendencies to progressing 'peripherisation' and elimination of borders has to be assessed with respect to potential structural changes in the material-intensive development patterns under Fordist regulation in ICs and partly in DCs (Lipietz, 1987).

The following rough hypothesis could be useful for such an assessment: The demand for materials and nature will probably increase still more with the intensification of economic, technological and socio-cultural globalisation, when the present structures of production/consumption, lifestyles and current resource productivities are supposed as constants (Daly/Goodland, 1994; Daly, 1996). Undoubtedly, two counterbalancing tendencies related to

globalisation can be expected: The first refers to an increasing scale that induces a total material input exceeding the already critical one at the present time. The other is the technologically feasible reduction of the resource intensity of the intermediate and final consumption processes.

Assuming a kind of technological scepticism, it can be hypothesised that as a net balance the scale effect will be stronger than the efficiency drive, and thus the growth put forward by globalisation will be more material-intensive than at the present time (see also the discussion in OECD, 1997). Furthermore, if the distribution share regarding global resource use remains unchanged between North and South, the ES –such as that already shared by ICs in disproportionate way– will be appropriated by the same ones in a more materially expansive and socially unjust manner. The double impact for the periphery would be the following: On the one hand, its marginalisation from resource use, when compared it with its normative ES, would be intensified. On the other, the over-proportional bearing of the environmental burden on global and local levels would continue, due to the over-use of materials and energy by ICs. The disparity in terms of ES between North and South would be aggravated, not to mention the social justice in intra- and intergenerational terms. Globalisation, material flows, ecosystem degradation and overstraining the environmental policy would go hand in hand with increasing uncertainties and risks, putting the co-evolution between man, culture and nature (Norgaard, 1994) under more complex stress with signs of unpredictable chaos and order (Prigogine/Stengers, 1994). The resulting conclusion is to pay particular attention to the social acting imperative, i.e. to make the precautionary principle valid and place an ESC with a proactive globalisation approach on the priority agenda.

Such an ESC allows for mediation through the market process, once the scale and distribution issues have been socially pre-established. The remaining resource allocation by the market steering could be made instrumental in principle by a global system of tradable rights of environmental use –in analogy to the tradable $C0_2$-emission certificates in relation to the *'international funds for global environment'*, such as that early advanced in the proposal of Earth politics by von Weizsäcker (1994: p. 210). In order to remain coherent with the input-based approach of ES, such a tradable permit

system has to be related particularly to primary material flows on the input side of the economy (Hinterberger et al., 1998).

According to such a scheme, the maximum material input levels would be fixed politically in yearly steps (e.g. 5% p.a.) in order to address the total target for DM (e.g. 90% after 50 years), by issuing the corresponding tradable permits under the same yearly reduction schedule, i.e. in proportion to the actually utilised ES. In the initial situation, the social actors (mainly corporate enterprises in the case of permits related to primary inputs) in ICs with an over-appropriated ES would receive disincentives for material use by means of proportionally less allocated permits; whereas the actors in DCs with an under-appropriated ES would benefit from proportionally more permits. The subsequent price formation would be performed by the market, for example by an international stock exchange for material input permits. As a result of the initial fixing and subsequent trade, the material input prices would regulate the demand jointly with increasing permit scarcity in view of the actual input use (implying the return of the corresponding permits to the issuing agency), and offer resource use in such a manner that the differentiated North-South reduction targets would be approximated and the overall direction of the DM path could be followed.

Clearly, many questions remain regarding institutional capacity (how to manage an appropriate stock exchange on a global level), technical know-how (how to fix the allowable material/permit amounts) and fiscal regulation (how to control the corresponding use and permit reduction), and must be discussed before this conceptual proposal will become real. However, it is not clear –at least concerning innovative conceptualisation– why the theoretically '*clean solution*' of tradable permits has so far been avoided politically by proposals of eco-tax reforms (von Weizsäcker/Jessinghaus, 1992, von Weizsäcker/Lovins/Lovins, 1997). Like the tradable permit proposal, the economic instrument of environmental tax is characterised by similar problems regarding its political implementation (e.g. due to missing procedures of internationally equal treatment, an absence of a clearing house mechanism for eco-taxed products at the national borders, etc.), although it cannot guarantee a consequent reduction of material flows as can potentially be done with the permit approach.

4.3 The real topic of the global ESC strategy: balancing out eco-efficiency and sufficiency

In many contributions to the debate on the strategy of DM and ESC, the focus has been directed to the relationship between the technological potential of eco-efficiency and the lifestyle-oriented challenge of eco-sufficiency (see, as an insight-providing essay, Femia/Hinterberger/Luks, 1996). This relationship implies an ambiguous "*walking on the ridge*" between economic growth based on new environmental technologies in the production process on the one hand, and societal well-being based on behaviour innovations in the consumption process on the other. Clearly, such a challenge also has its consequences for the international distribution of the corresponding responsibilities between the North and the South as well as for the scope of new wealth models in the present periphery societies of the world system.

Without doubt, the "*efficiency revolution*" (von Weizsäcker/Lovins/Lovins, 1997) is being increasingly adopted by the international "*green business*" (in particular WBSD) as a way to raise resource productivity in the distinct phases of the corresponding product's life-cycle (Hawken/Lovins/Lovins, 1999: 62-81). Its potential for contributing to de-materialised production and consumption, with an accentuated focus on the North, and therefore to a less stressed environment, can be hardly questioned. Thus, it has attracted particular attention by means of campaigns and initiatives, such as those carried out recently by Friends of the Earth, IISD and the OECD (FoEI, 1997; OECD, 1995) in order to cope with the mandate given by chapter 4 of Agenda 21.

Additionally, the so-called "*industrial ecology*" (Ayres/Ayres, 1996) has attracted a broad group of scientists, engineers, product-designers, economists, etc., who are working on better product/process-efficiency by means of energy savings and reforms, material cycle closing, waste minimisation, durable and re-usable product design, reduction of transport distances, eco-auditing and eco-efficient services and other recent findings of dematerialisation research. Similarly, diverse initiatives have been taken up to support the ecological (partly social) innovations at the basis of communities and enterprises –such as the remarkable "*natural step*" movement

(Karl-Henrik Robert, et al.) in Sweden, Australia and USA, which is quite promising.

However, an important doubt –if not outright opposition– arises with regard to a naïve or propagandistic overvaluation of the real role of eco-efficiency in relation to its net effect for reducing the throughput when the growth dynamics affecting it are considered in the wave of an efficiency revolution with increasing scale impacts. This bias of eco-efficiency towards illusionary impact imagination is implicit also in some of the contributions discussed above concerning ESC (e. g. von Weizsäcker).

With its focus on the micro level of material intensity reduction which is normally assessed by a kind of "*partial equilibrium analysis*," the "popular" stance of Factor 4 (or 10) tends not to consider the simultaneous *rebound effects* of income and demand as also valid in eco-efficient economies (see Binswanger, 1993, 2001). Therefore, it cannot be neglected by premise, that the gains corresponding to the growing resource productivity would not be overcompensated by corresponding effects on price and income. These tend to dynamise the intermediate and final demand and thus increase –in the net result– the material-energy flow induced by the force of this demand. Such a *rebound effect* will be still more probable if the eco-technological gains are not taxed away at their source or allocated to additional ecological investments which explicitly favour the DM targets (Wackernagel/Rees, 1997: p. 18).

In order to assess the real potential of eco-efficiency for a comprehensive ESC in its relevance for the North-South relationship, the interplay between (1) existing clean technologies for waste/pollution treatment, (2) uncertain technological progress for its incorporation in product and process innovations (intra-sector eco-efficiency), and (3) structural evolutionary changes of production and consumption patterns (inter-sector eco-efficiency/societal sufficiency) must be explored. Ideally this should be done with an input-output analysis based on material flow accounting with a welfare orientation to services (see Femia et al., 1996: p. 10). Thus, the relative share of the above components (1-3) of efficiency and sufficiency could be better examined, as well their total contribution with regard to the hypothesised de-linking of economic growth from material throughput. Both the theoretical analysis (Ibid.: 14-26) and most empirical EKC studies (see section 4.1) demonstrate quite

convincingly that the emphasised de-coupling remains within limits whose characteristics and causes cannot be presented here in detail (13).

Thus, all significant elements of an ESC have to come together to influence an environmentally sound production and consumption pattern, including:

- measures to reduce energy, material and waste in industrial ecology,
- technological progress and change in the production structure, and
- societal transformation by means of eco-efficient services and greater sufficiency due to changed end-use patterns and individual/social lifestyles.

When the scenario of DM is established in this manner, it can be stated that ultimately the socio-cultural and institutional change of societal structures, attitudes and value settings constitute the only sufficient condition for the proposed reduction of nature consumption without violating social well-being.

This has to be built on sufficiency strategies, such as those represented by the four E's of Sachs (1993): '*reducing the speed*' ('*Entschleunigung*'), '*reducing economic integration*' ('*Entflechtung*'), *de-commercialisation* ('*Entkommerzialisierung*'), and '*appreciation of simpler goods and lifestyles*' ('*Entrümpelung*')" (Femia et al., 1996: p. 36).

However, it must to be analysed with some scepticism whether the outlined metaphors of new wealth models and solidarity/community values will have any chance to rise/survive as a '*real policy*' in view of the current reorientation of social and individual actors to material value attitudes (job, income, basic or conspicuous consumption instead of environment, nature amenities and communal lifestyles) in the context of intensifying processes of globalisation and border-elimination with the impact of social trauma for human/societal relationships both in North and South.

As will be further discussed in the next section, an ESC on an international level implies new forms of technology and science transfer, profound changes in economic, technical, financial and

cultural development co-operation, new ways of environmental joint ventures, etc. This occurs if one does not wish to be an advocate of a strategy of de-coupling from the world economy/society with the aim of a self-centred development, but does aim to go beyond the present impasse of development thinking imposed –among others– by 'simplistic' dependency approaches (see also Schurmann, 1993). A de-linking from the world market tends to turn out to be a quite irresponsible illusion when it is confronted with the already internationalised environmental degradation and the joint threat for the global commons of the Earth's ecosystems.

5. Some basic North-South characteristics of the ESC: outline of a research agenda

The fundamental ambiguity of the strategy based on a more equally utilised ES and on dematerialisation in ICs has been stressed above in terms of the underlying North-South relations. On the one hand, such a strategy would open some relative margins for action in the South in order to maintain or renew material/energy-intensive growth in correspondence to its historically under-appropriated ES for global resources. This would be equivalent to a promising development potential in which exports to ICs will play an important role.

On the other hand, it is to be expected that the exportation performance and hence the growth dynamics in many Southern economies will be shocked by the measures of restructuring towards a higher eco-efficiency in the countries of the North. This occurs because the dematerialisation push in the North tends to limit the importation of primary products of agricultural/mineral origin, as well as of manufactured final commodities with a material-intensive product cycle within the DCs. Thus, it would create barriers for access to important markets in ICs, due to ecological taxes on material flows and due to standards for a product design requiring a reduced resource input, and so on.

In other words: the potential of a relatively dematerialised economy in ICs tends to go hand in hand with a process-like protectionism with an *"ecological face*." From the perspective of the South, such an import restriction turns out to be quite cynical in view of its recent adjustment experience. In past years most dynamic export economies in the world periphery have been reshaped in

favour of non-traditional export goods –principally agrarian or agro-industrial products with high resource intensity– for new markets in the North, by giving priority to trade liberalisation and structural adjustment programs such as those specified by the Bretton Woods institutions under the hegemony of ICs (see Reed, 1996; for the case of Costa Rica, see Fürst, 1992).

This ambiguous process of *'advancing on the ridge'* between a missing *ex-ante* rationale for action (in our case, the ESC that has to be initiated now and not only tomorrow) and a plausible claim to provide DM with an analytically-safe basis and the corresponding eco-policy on the grounds of Ecological Economics (see, in general, Hinterberger et al., 1998) are also valid for the ecological reforms directed to the North-South problem (see section 5). Here in particular, the present globalisation with its inherent tendencies to progressing 'peripherisation' and elimination of borders has to be assessed with respect to potential structural changes in the material-intensive development patterns under Fordist regulation in ICs and partly in DCs (Lipietz, 1987).

The following rough hypothesis could be useful for such an assessment: The demand for materials and nature will probably increase still more with the intensification of economic, technological and socio-cultural globalisation, when the present structures of production/consumption, lifestyles and current resource productivities are supposed as constants (Daly/Goodland, 1994; Daly, 1996). Undoubtedly, two counterbalancing tendencies related to globalisation can be expected: The first refers to an increasing scale that induces a total material input exceeding the already critical one at the present time. The other is the technologically feasible reduction of the resource intensity of the intermediate and final consumption processes.

Assuming a kind of technological scepticism, it can be hypothesised that as a net balance the scale effect will be stronger than the efficiency drive, and thus the growth put forward by globalisation will be more material-intensive than at the present time (see also the discussion in OECD, 1997). Furthermore, if the distribution share regarding global resource use remains unchanged between North and South, the ES –such as that already shared by ICs in disproportionate way– will be appropriated by the same ones in a more materially expansive and socially unjust manner. The double

impact for the periphery would be the following: On the one hand, its marginalisation from resource use, when compared it with its normative ES, would be intensified. On the other, the over-proportional bearing of the environmental burden on global and local levels would continue, due to the over-use of materials and energy by ICs. The disparity in terms of ES between North and South would be aggravated, not to mention the social justice in intra- and intergenerational terms. Globalisation, material flows, ecosystem degradation and overstraining the environmental policy would go hand in hand with increasing uncertainties and risks, putting the co-evolution between man, culture and nature (Norgaard, 1994) under more complex stress with signs of unpredictable chaos and order (Prigogine/Stengers, 1994). The resulting conclusion is to pay particular attention to the social acting imperative, i.e. to make the precautionary principle valid and place an ESC with a proactive globalisation approach on the priority agenda.

Such an ESC allows for mediation through the market process, once the scale and distribution issues have been socially pre-established. The remaining resource allocation by the market steering could be made instrumental in principle by a global system of tradable rights of environmental use –in analogy to the tradable $C0_2$-emission certificates in relation to the *'international funds for global environment'*, such as that early advanced in the proposal of Earth politics by von Weizsäcker (1994: p 210). In order to remain coherent with the input-based approach of ES, such a tradable permit system has to be related particularly to primary material flows on the input side of the economy (Hinterberger et al., 1998).

According to such a scheme, the maximum material input levels would be fixed politically in yearly steps (e.g. 5% p.a.) in order to address the total target for DM (e.g. 90% after 50 years), by issuing the corresponding tradable permits under the same yearly reduction schedule, i.e. in proportion to the actually utilised ES. In the initial situation, the social actors (mainly corporate enterprises in the case of permits related to primary inputs) in ICs with an over-appropriated ES would receive disincentives for material use by means of proportionally less allocated permits; whereas the actors in DCs with an under-appropriated ES would benefit from proportionally more permits. The subsequent price formation would be performed by the market, for example by an international stock exchange for material input permits. As a result of the initial fixing

and subsequent trade, the material input prices would regulate the demand jointly with increasing permit scarcity in view of the actual input use (implying the return of the corresponding permits to the issuing agency), and offer resource use in such a manner that the differentiated North-South reduction targets would be approximated and the overall direction of the DM path could be followed.

Clearly, many questions remain regarding institutional capacity (how to manage an appropriate stock exchange on a global level), technical know-how (how to fix the allowable material/permit amounts) and fiscal regulation (how to control the corresponding use and permit reduction), and must be discussed before this conceptual proposal will become real. However, it is not clear –at least concerning innovative conceptualisation– why the theoretically '*clean solution*' of tradable permits has so far been avoided politically by proposals of eco-tax reforms (von Weizsäcker/Jessinghaus, 1992, von Weizsäcker/Lovins/Lovins, 1997). Like the tradable permit proposal, the economic instrument of environmental tax is characterised by similar problems regarding its political implementation (e.g. due to missing procedures of internationally equal treatment, an absence of a clearing house mechanism for eco-taxed products at the national borders, etc.), although it cannot guarantee a consequent reduction of material flows as can potentially be done with the permit approach.

Hence, it has to be asked which of the two stressed tendencies –growth push versus export diminishing– will predominate. Of course, this question cannot be answered without a detailed analysis of the performance conditions for ESC. With the current state of knowledge, it is not clear for the South if the increased exploitation of its remaining ES will allow for sufficient growth initiatives to compensate for the simultaneous growth restrictions due to the emerging entry barriers in the form of tariffs (environmental taxes) or non-tariffs (ecological quality standards), both levied with regard to material-intensive imports from the DCs. Due to this dilemma a research agenda must be established to assess the overall effects and feedback as well as design certain key elements for a sustainable development strategy in DCs considering their relation with the North.

Such an agenda must focus on the environmental ambivalence of foreign trade and globalisation (see OECD, 1997). As Daly (1993, 1996: p. 145, 1999: pp. 22-23), Facheux/O'Connor/Nicholai (1997), and

other ecological economists (see, e.g., the contributions in the *Ecological Economics Bulletin of ISEE*, 2 (3). Third Quarter, 1997) have pointed out, it can be expected that the uncontrolled expansion of world trade and finance under the current conditions of corporate power relationships, demand structures and regulation regimes will have a negative ecological impact in the form of a globally increased throughput with the most damage in the South. This would imply a free-trade scenario with increased *"ecological footprints,"* resulting from an intensified material growth both in ICs and in semi-industrialised newcomers in the context of their competition directed to the assumed benefits of the globalisation race (Wackernagel/Rees, 1997:p. 15).

In view of this picture of environmentally and socially uncertain globalisation, it is important to call for an "*ecological-economic trade policy*" which must go beyond the Factor 10-postulate and the efficiency revolution –both based on a technologically better performance of the material life-cycle of products– in the societies of the North. Such rethinking on *'environment, trade and development'* (14) evidences a need for further research which has to be addressed with new approaches towards sustainable North-South relationships. This could be done through case studies by focusing on the material contents and ecological footprints of bilateral trade flows between selected ICs and DCs. Another research focus is related to a critical analysis of the political institutional conditions of international trade regimes (in particular the regulations in the GATT regarding TBT and SPS), the national, regional, or international demands for quality products based on certified environmental management systems and life-cycles (e.g. ISO 14000), and other changes of a regulatory kind which could and should favour the South under the buzzword "*Greening the GATT*" (Esty, 1994).

Furthermore, research should identify the real opportunities and limitations of emerging market niches for ecological export products from DCs, the corresponding procedures of green certification and the marketing of environmental services, such as the sequestering of carbon by tropical rain forests. A concrete assessment of these innovations must begin by the consideration of proposals for institutional policy alternatives to the present trade regimes and international institutions with competence for structural adjustment, etc. Hence, research should focus on an international policy for structural change with a strategic

orientation, a field of trade and development where the issues analysed are still in very initial stages. Therefore, more efforts are required for ecological economics oriented towards the issue of globalisation, trade and environment (Facheux/O'Connor/Nicholai, 1997; Fürst, 2000), in order to bridge the gap and challenge the present leadership of the neo-classical mainstream of development economics in this area of policy prescription.

The same is valid for the second topic on the research agenda for international ESC from the perspective of the South. This issue requires an urgent change in international development co-operation. This is already being faced today and will be challenged still more in the near future with demands of DCs directed to ICs, such as:

- addressing the *"ecological debt,"* i.e. compensation for environmental degradation and the corresponding ES violation due to a Fordist growth of the highly industrialised countries in the past,
- payments for global environmental services which are over-proportionally used by the North, but provided by ecosystems located within the borders of the nation-states of Southern countries,
- cost-subsided transfers of clean technologies and problem-adapted *blueprints* for eco-efficient process/product innovations from the North to the South,
- technical and financial co-operation in favour of the productive and reproductive restructuring under an ecological label in the South, i.e. following true *joint implementation*.

With regard to the ESC in the DCs, the main task of ecological-economic development research is to identify the specific local conditions for strong backward and forward linkages, adequate income distribution between sectors and within society, and a surplus destination based on sustainable development criteria. All of these are related to the domestic push of ecological restructuring due to the reforms (described above) of international trade and co-operation modalities.

In this context, particular attention should be paid to the negative tendency of some promising innovations, e.g. retributions for environmental services in the periphery, when these novelties follow the logic of renewed rent-seeking for compensation businesses, giving way to a reshaping of technological dependencies and an

emergence of a new conditionality with an environmental face. This seems to be present in the currently predominating modalities of joint implementation and bio-prospecting which are oriented mainly towards the purpose of finding mechanisms for compensating for the corresponding ecosystem functions and services (e.g. greenhouse gas sequestration, biodiversity conservation), without attacking the problem at its root. At the moment, many co-operation projects in this field have to be challenged by critical questions behind this tendency.

This opens the perspective towards the central issue of ecological reforms regarding the economy and the conventional set of economic policy instruments in the South itself. The corresponding research and policy co-operation which virtually has to recognise the competence of local counterparts, would have to focus on the structural transformation from resource and pollutant-intensive production and consumption patterns tending towards dematerialised resource processing and demand structures. It seems quite misleading to expect substantial impacts in the form of greener production and consumption in the South mostly from cleaner end-of-pipe technologies and the monetary internalisation of external environmental costs. Undoubtedly, the reforms have to find an adequate combination of preventing and mitigating components within a coherent eco-policy, giving preference to proactive ESC elements. It seems appropriate to design the corresponding structural change strategy using well-designed instruments of *green* incentive and promotion policies which can be market-oriented where they seem to give suitable results.

The suggested comprehensive policy for an ESC in the South could include the following features:

- productive transformation of the processes of cultivation, harvest and other uses of primary goods in resource-based sectors (agriculture, etc.), by giving way to restructuring in compliance with innovative, environmentally friendly technology packages with regard to both material input and pollutant output (e.g. ecologically-safe pesticide utilisation);
- socially creative '*setting in value*' of local ecosystem services (e.g. the carbon cycle function of tropical forests), by focusing on community development potentials in DCs rather than on 'pure' foreign currency generation by the world market for such services, unless the latter is based on strategically-

planned bilateral exportations or real participation of people in the benefits of the commerce of ecological function certificates on international stock exchanges (e.g. the incipient carbon trade);

- pro-active structural policy of food security, satisfaction of basic needs and poverty reduction on the basis of local-regional networks of production chains, commodity and labour markets, small producer and consumer relationships, as well as by promoting communal living organisation of rural and urban households with material-low production process and lifestyle patterns (see e.g. Duchin, 1996b);
- ecological-technological and societal innovations deliberately directed to build up a systemic competitive capacity with an environmental profile in export-oriented sectors, industries and enterprises (Eßer et. al., 1996; Freeman, 1993; Porter/van der Linde 1995);
- eco-policy instruments of tax, price and incentive reforms oriented towards the promotion of socially fair and environmentally sound consumption structures, by focusing, in particular, on a comprehensive eco-tax package which could induce a kind of double dividend –social justice and environmental protection– with a relatively higher relevance in Southern than in Northern countries. It should be reshaped especially towards natural resource/material inputs and less towards pollutants corresponding to the local output side, such as greenhouse gas emissions (due to its relatively small source relevance in DCs);
- institutional arrangements which would promote real participatory processes for societal stakeholder dialogue and a more democratic type of decision-building on key issues of development policy, in order to allow for a social actor-oriented internalisation of environmental costs within a set of macro and micro decisions on ESC, including the democratic canalisation of transparent social conflicts.

With these topics, only some basic "*flashing-lights*" that intend no more than to indicate a gradual transformation towards structures of production, consumption and decisions under the challenge of sustainable development in the South, have been fixed. Of course, the innovations required for sustainable development are always subject to evolution characterised in principle by non-determinateness from the present perspective.

However, at this point it should be reiterated that a domestic ESC in the South will always remain incomplete if it is not accompanied, or even preceded by an overall ESC and governance at the level of global capitalism (see e.g. Altvater / Mahnkopf, 1996; and Hein, 1999), in particular in Northern industrial societies. Today, more than at the end of the eighties, a kind of *'earth policy'* is challenged with profound institutional reforms for a structural change, such as those designed by von Weizsäcker (1994) at a relatively early date (for the first time in 1989). In this proposal the so-called *"world conference for environment"* assumes an outstanding role. The constituents of this kind of *"International Environmental Organisation"* analogous to IMF and WTO, but with an NGO-approach (see also Esty, 1997), consist of an internationally virtual environmental charge levied on CO_2 emissions, the corresponding funds financed by such charges, and, in particular, the inherent redistribution mechanism directed to finance some premium-bonus related to carbon absorption and biodiversity conservation. The elements emphasised can be seen as pioneering ideas for an Earth policy-reform that on a global governance level would sustain the above-mentioned ESC institutionally and financially.

6. Conclusions

On the basis of the reflections above in sections 2-5, the main issues raised in the introduction (section 1) can be now '*answered*' as a way to conclude. Sustainable development –reassessed here as an ESC in the context of the global eco-space– is to be best interpreted as a co-evolution between society and nature in its broadest sense. Thus, a socially and technologically induced increase in productivity is implied in the general term '*societal innovation*.' Therefore, in principle a de-linking of economic growth from its material content can be thought as potential, by taking the form of a significant resource input reduction. However, this de-linking between human-made wealth production and its environmental life-support functions finds its material and thermodynamic limits in all societies based on industrial metabolism. These limits will be valid even in future service-based societies with forms of Post-Fordist regulation. The implied scope of dematerialisation is determined ultimately by the (material-intensive) scale effect of economic activity.

In a worldwide economy where the ESC remains limited to eco-efficiency, but the socio-economic rationale continues to be based on monetary value maximisation, the macro-physical growth drive is expected to have a dimension that cancels out the resource-saving effects per product. This means that due to the remaining rebound effects, etc. on an aggregate level, the scale is '*eating up*' the resource productivity gained on the level of individual products. However, the scale is not only an absolute physical size problem regarding the material/resource flow as such; rather it represents a relative system size order with an inherent risk potential in relation to the capacities of resilience and self-organisation of the underlying ecosystems. Of course, the scale –interpreted here as a persistent systemic tension relationship between man and nature– can be relaxed and tightened, in dependence on the societal regulation form at worldwide and '*national*' levels, by means of sound technological, environmental and development policies (such as those outlined in section 5), but ultimately the scale problem cannot be "*developed away*."

Hence, this socio-ecological trade-off is a constant with regard to the capabilities of evolution both of the economy and supporting ecosystems. It represents a constant which is in principle independent on the concrete organisation of the economy as a Fordist or Post-Fordist form of accumulation. However, the scale problem,

considered as an ultimate risk, has much to do with the initial societal conditions of an open-event evolution. Thus, it has to be perceived also as a variable dependent on the issue of social distribution and other institutional-societal innovations.

Both the economic-biophysical scale and social equity are intimately linked with regard to the underlying societal/ethical value orientation, stakeholder negotiation and decision-making, a fact that does not neglect its significance even when an evolutionary perspective is adopted with ethical responsibility.

It appears that an adequate treatment of the outlined complexity is allowed for by a further analytical development and political debate with regard to the pioneering categories of ES and ESC. Therefore, it is true that the still pending task for operationalising this central feature of sustainable development must focus on the redistribution of (access to) the global wealth of the natural resources, differentiating in this manner the need for reducing resource consumption. The corresponding scopes for reduction/redistribution have to be determined politically within an ESC, which accounts for both the future generations and the better opportunities for equities between the North and the South. An ESC with such features cannot limit itself to a pure efficiency revolution such as the appealing movement appears to be with an increasing amount of acknowledgement thus far.

It can be concluded that a significant change of the societal welfare model in its international context of more sustainable North-South relations could allow for a scale with a permissive risk margin situated within the ever-fragile stability as permitted by a permanent switching between chaos and order in evolutionary development. Achieving an ESC with the characteristic socio-economic well-being and global governance, such as those outlined above as emerging tendencies, and attending an urgent research and policy agenda, remain the main challenge for an overall advance towards sustainable development. Surely with different features in the North and South, this agenda has to be addressed both by scholars of (ecological) development economics and by actors of the global civil society.

Notes

1. See this debate in: Amin, 1994; Amsden, 1990; Jessop, 1992; Lipietz, 1987, 1992, 1997; Hein 1995, 1999.
2. For a good overview of the debate on the EKC, see de Bruyn, 1999; and Ekins, 1997, 2000: pp. 182-214.
3. See the studies on "*Sustainable Europe*" by FoEN, 1993; FoEE 1995; BUND/MISEREOR, 1996; Spangenberg, 1996.
4. See, among many others, Bringezu, 1995: 35. The term '*hidden flows*' which is equivalent to '*ecological rucksacks,*' is used by Adriaanse et al., 1997: 6.
5. Femia/Hinterberger/Luks, 1996; Hinterberger/Schmidt-Bleek, 1999; Schmidt-Bleek et al., 1999.
6. Rees/Wackernagel, 1994; Wackernagel/Rees 1996; Wackernagel et al., 1998. For a recent debate, see the *Special Issue of Ecological Economics*, 32 (3). March 2000.
7. In my specific context of argument, the social asymmetry of ES-utilisation is stressed for the dimension of international relationships. Of course, this can be also related to the intrasocietal dimension, focusing on the inequality between social groups and classes in terms of their over- and under-appropriation of available ES levels for resource consumption. In this case, the resources considered have a more national or local character (without neglecting the relevance of global resources for intrasocietal inequity) and the unjust consumption patterns between social classes reflect the underlying unequal distribution of wealth and power in the corresponding society. Thus, the latter distribution issue can be seen as a key obstacle for a sustainable society, both in environmental and socio-economic terms, implying that priority should be given to the challenge of social equity in the process of approaching a real SD-strategy, i.e. supported by the now marginalised groups and actors. For the social (in)equality issue in the SD-debate, see Martinez-Alier and O'Connor, 1996)
8. See e.g. Harborth, 1991; Goodland/Daly, 1991; Bhaskar/Glyn, 1995; Wackernagel/Rees, 1996, Wackernagel et al., 1998. The numbers illustrated in these and the other referred studies with regard to the international disparity from a historical-biophysical perspective cannot and shall not be reproduced here in detail.

9. See, among others, de Bruyn/Opschoor, 1997; de Bruyn/van den Bergh/Opschoor, 1998; de Bruyn/Heintz, 1999; Ekins, 1997, 2000 (chapter 7); Stern, 1998.
10. See the contributions to the EKC sessions of the fourth international meeting of the *ISEE-International Society for Ecological Economics*, August 1996, in Boston, USA, and mainly published in the *Special Issue of Ecological Economics*. 25(2). May 1998, in particular the highly interesting contributions of Rothman and Suri/Chapman.
11. For example, in journals such as *Ecological Economics*. 15:2, and *Environment and Development Economics*. 1:1.
12. For two more recent empirical studies on the industrial metabolism in Ics, see Adriaanse et al., 1997 and Matthews et al., 2000.
13. See, in particular, Femia et al., 1996: 25; and BUND/MISEREOR 1996: 370. For a more explicit background see de Bruyn, 1999, chapters 4 and 8.
14. The corresponding topic "*trade & environment*" has led recently to a vast amount of literature. See Dean, 1992, for an already classical overview of the general theoretical debate. For a review of the empirical evidence, see Thompson/Strohm, 1996. The political debate about how to restructure international trade towards environmentally sound features is reflected with a distinct focus in UNCTAD, 1995 and FoEI, 1997. Regarding the problem for Costa Rica, see Conejo/Diaz/Fürst/Gitli/Vargas 1999.

References

Adriaanse, A. et al. 1997. Resource Flows: The Material Basis of Industrial Economies. Washington, D.C.: World Resources Institute (WRI).

Altvater, E. and Mahnkopf, B. 1997. Grenzen der Globalisierung. Ökonomie, Ökologie und Politik der Weltgesellschaft. Münster: Westfälisches Dampfboot.

Amin, A. 1994. "Post-Fordism: Models, Fantasies and Phantoms of Transition." In: Post-Fordism. A Reader. Ed. Amin, A. Oxford: Oxford University Press, pp. 1-39.

Amsden, A. 1989. Asia's Next Giant. Oxford, U.K.: Oxford University Press.
---------- 1990. "Third World Industrialisation: 'Global Fordism' or a New Model." *New Left Review*. 182 (July/August): pp 5-32.

Arrow, K. et al. 1996, Economic Growth, Carrying Capacity, and the Environment. Environment and Development. 1(1): pp. 104-110.

Ayres, R.U. 1994. "Industrial Metabolism: Theory and Policy." In: Industrial Metabolism. Eds. Ayres, R. U. and Simonis, U. E. Tokyo-New York: UN University Press, pp. 3-31.

Ayres, R.H. and Ayres, L.W. 1996. Industrial Ecology. Towards Closing the Materials Cycle. Cheltenham and Brookfield: Edward Elgar.

Bhaskar, V. and Glyn, A. (eds.) 1995. The North, the South and the Environment. London and Tokyo: Routledge

Binswanger, M. 1992. Information und Entropie. Ökologische Perspektiven des Übergangs zur Informationsgesellschaft. Frankfurt a. M. and New York: Campus.
---------- 1993. "Gibt es eine Entkopplung des Wirtschaftswachstums von Naturverbrauch und Umweltbelastung?" Diskussion Papiere No. 112. St. Gallen: Institut fur Wirtschaft und Ökologie.
---------- 2001. "Technological Progress and Sustainable development: What about the Rebound Effect?" *Ecological Economics*. 36 (1): pp. 119-132.

Bringezu, S. (Hg.) 1995. Neue Ansätze der Umweltstatistik: Ein Wuppertaler Werkstattgespräch. Berlin-Basel-Boston: Birckhäuser-*Wuppertal Texte.*

BUND/MISEREOR (Hrsg.) 1996. Zukunftsfähiges Deutschland. Ein Beitrag zu einer global nachhaltigen Entwicklung. Basel u.a.: Birckhäuser - WIKUE.

Castells, M. 1996-1998. The Information Age. Vol. I: The Rise of the Network Society (1996). Vol. II: The Power of Identity (1997). Vol. III: The End of Millennium (1998). Oxford: Blackwell.

CEPAL 1990. Transformación productiva con equidad. La tarea prioritaria del desarrollo en América Latina. Santiago de Chile: CEPAL/ECLAC.
---------- 1996. Fortalecer el desarrollo. Interacciones entre macro y microeconomía. Santiago de Chile: Naciones Unidas.
---------- 1998. América Latina y el Caribe: políticas para mejorar la inserción en la economía mundial. Santiago de Chile y México, D.F.: CEPAL y Fondo de Cultura Económica.

Conejo, C., Diaz, R., Fürst, E., Gitli, E. and Vargas, L. 1999. “Costa Rica.” In: Reconciling Trade and the Environment. Lessons from Case Studies in Developing Countries, chapter 7. Eds. Jha, V., Markandya, A. and Vossenaar, R. (UNCTAD). Cheltenham, UK and Northampton, MA, USA: Edward Elgar 1999.

Costanza, R. (ed.) 1991. Ecological Economics. The Science and Management of Sustainability. N.Y.: Columbia University Press.
----------, Martinez-Alier, J., Segura, O. (eds.) 1996. Getting Down to Earth. Practical Applications of Ecological Economics. Washington, D.C.-Covelo, CA: Island Press-ISEE.

Cruz, W., Warford, J., Schwab, A. and Hansen, S. 1997. The Greening of Economic Policy Reform: Vol. I: Principles; Vol. II: Case Studies. Washington, D.C.: IBRD.

Daly, H. 1991. Steady-State Economics (Second Edition with new Essays). Washington, D.C.: Island Press.
-------- 1993. "The Perils of Free Trade." *Scientific American*. 269 (5): pp. 50-57.
-------- 1996. Beyond Growth. The Economics of Sustainable Development. Boston, Mass.: Beacon Press.
-------- 1999. "Globalisation versus Internalisation – Some Implications." *Ecological Economics*. 31 (1): pp. 31-37.
---------- and Goodland, R. 1994. An Ecological-Economic Analysis of Deregulation of International Commerce under GATT. *Ecological Economics*, 8 (1): pp. 73-92.

Dean, J. 1992. "Trade and the Environment: A Survey of the Literature." In: International Trade and the Environment. Ed. Low, P. Washington, D.C.: IBRD-World Bank Discussion Papers No. 159.

de Bruyn, S.M. 1999. Economic Growth and Environment. An Empirical Analysis. Amsterdam: Tinbergen Institute Research Series No. 216.
---------- and Opschoor, J.B. 1997. "Developments in the Throughput-Income Relationship: Theoretical and Empirical Observations." *Ecological Economics*. 20(3): pp. 255-268.
----------, Bergh, J. C. van den and Opschoor, J.B. 1998. "Economic Growth and Patterns in Emissions; reconsidering the Empirical Basis of the Environmental Kuznets Curve." *Ecological Economics*. 25(2): pp. 161-175.
---------- and Heintz, R. 1999. "The Environmental Kuznets Curve Hypothesis." In: Handbook of Environmental and Resource Economics. Ed. Bergh, J.C. van den. Cheltenham, UK and Northampton, USA, pp. 656-677.

Duchin, F. 1996a. “Ecological Economics: The Second Stage.” In: Eds. Costanza, R., Martínez-Alier, J. and Segura, O., pp. 285-300.
---------- 1996b. Household Lifestyles: The Social Dimension of Structural Economics. New York: New York University.

Edquist, C. (ed.) 1997. Systems of Innovation: Technologies, Institutions and Organisations. London: Pinter.

Ekins, P. 1997. "The Kuznets Curve for the Environment and Economic Growth: Examining the Evidence." Environment and Planning A. 29: pp. 805-830.
---------- 2000. Economic Growth and Environmental Sustainability. The Prospects for Green Growth. London and New York: Routledge.

Eßer, K., Hillebrandt, W., Messner, D. and Meyer-Stahmer, J. 1996. Systemic Competitiveness. New Governance Patterns for Industrial Development. London: Frank Cass.

Esty, D. 1994. Greening the GATT: Trade, Environment and the Future. Washington, D.C.: Institute for International Economics.
---------- 1997. "Why the World Trade Organisation needs Environmental NGOs?" Bridges- Public Participation in the International Trading System. Geneva: International Centre for Trade and Sustainable Development. (ICTSD).

Facheux, S. 1997. "Technological Change, Ecological Sustainability and Industrial Competitiveness." In: Sustainablility and Global

Environmental Policy – New Perspectives. Eds. A.K. Dragun and K.M. Jakobsson. Cheltenham: Edward Elgar, pp. 46-67.
----------, O'Connor, M. and Nicholai. I. 1997. "*Economic Globalisation, Competitiveness, and Environment.*" In: Ed. OECD, pp. 101-139.

Factor 10 Club 1994. Factor 10 – Carnoules Declaration. Wuppertal: Wuppertal Institute.

Femia, A., Hinterberger, F. and Luks, F. 1996. "Ecological Sustainability, Economic Growth, Individual Well-Being ... and Dematerialisation." Ms. prepared for Structural Change and Economic Dynamics (SCED), Oxford University Press.

FoEE–Friends of the Earth Europe (ed.) 1995. Towards Sustainable Europe. Brussels, Belgium: FoEE.

FoEI–Friends of the Earth International 1997. "Trade, Environment and Sustainability." http://www.foe.co.uk/ foei/tes.

FoEN–Friends of the Earth Netherlands (ed.) 1993. Action Plan Sustainable Netherlands. Amsterdam, The Netherlands: FoEN.

Freeman, C. 1992. The Economics of Hope. Essays on Technical Change, Economic Growth and the Environment. London: Pinter.

Fürst, E. 1992. Liberalización comercial y promoción de exportaciones en Costa Rica (1985-1990). Limitaciones y desafíos en la política de ajuste estructural reciente. Heredia, Costa Rica: Editorial FUNA y Maestría en Política Económica – Serie Política Económica No. 1.
---------- 1999. "Globaler Ressourcenverbrauch, Umweltraum und ökologischer Strukturwandel. Implikationen für die Nord-Süd-Beziehungen." In: Eds. W. Hein and P. Fuchs, pp. 77-124.
---------- 2000. "Globalización, espacio ambiental y cambio estructural desde la perspectiva del Sur." In: Costa Rica: cambio estructural en la economía y el ambiente. Una evaluación de múltiples criterios. Ed. Fürst, E. Heredia, Costa Rica: Editorial FUNA, pp. 50-87.
---------- and Hein, W. 2001. Turismo de larga distancia y desarrollo regional en Costa Rica. Estudios sobre la relación entre turismo y desarrollo sostenible en los ámbitos global, nacional y micro-regional. Heredia, C.R.: Editorial FEUNA (forthcoming).

---------- and Orozco, J. 2000. "Crecimiento económico, cambio estructural y desempeño ambiental: replanteamiento de la hipótesis de la Curva Kuznets Ambiental (EKC)." In: Costa Rica: cambio estructural en la economía y el ambiente. Una evaluación de múltiples criterios. Ed. Fürst, E. Heredia, Costa Rica: Editorial FUNA, pp. 141-180.

Goodland, R. and Daly, H. 1992. "Ten Reasons Why Northern Income Growth Is Not the Solution to Southern Poverty." In: Population, Technology and Lifestyle. Robert Goodland et al. Washington, D.C. and Covelo, Cal.: IBRD/Island Press, pp. 128-145.

Grossman, G.M. and Krueger, A.B. 1995. "Economic Growth and the Environment." *Quarterly Journal of Economics* 112: pp. 353-378.

Harborth, H.J. 1991. Dauerhafte Entwicklung statt globaler Selbstzerstörung. Eine Einführung in das Konzept des “Sustainable Development.” Berlin: Ed. Sigma.

Hawken. P., Lovins, A. and Lovins, H. L. 1999, Natural Capitalism: Creating the Next Industrial Revolution. Boston-New York-London: Little, Brown and Company.

Hein, W. 1995. "Von der fordistischen zur post-fordistischen Weltwirtschaft." Peripherie 15 (59/60): pp. 45-78.
---------- 1997. "Globalisierung und nachhaltige Entwicklung in den Ländern des Südens." In: Nachhaltigkeit. Eds. Rennings, K and O. Hohmeyer. Baden-Baden: *ZEW-Wirtschaftsanalysen, Bd. 8*, pp. 165-218.
---------- 1998. "Tourism and Sustainable Development: Empirical Analysis and Concepts of Sustainability. A Systems Approach." In: Tourism and Sustainable Development. Ed. W. Hein. Hamburg: (DÜI), pp. 59-400.
---------- 1999. "Postfordistische Globalisierung, Global Governance und Perspektiven einer Strategie ‘Nachhaltiger Entwicklung’ in evolutionstheoretischer Sicht." In: Eds. W. Hein and P. Fuchs, pp. 13-76.
---------- 2000. “Global Governance and the Evolution of a New Role of International Financial and Economic Institutions for Sub-Saharan Africa." African Development Perspectives Yearbook Vol. 8. Bremen
---------- and P. Fuchs (Eds.) 1999. Globalisierung und ökologische Krise. Hamburg: DÜI.

Hinterberger, F., Luks, F. and Stewen, M. 1998. Ecological Economic Policy Between Eco-Dictatorship and Environmental Catastrophe. London: Earthscan.
---------- and Luks, F 1998. "*Dematerialisation, Employment and Competitiveness in a Globalised Economy."* Paper prepared for the Plenary Session 1 of the Fifth Biannual Conference of the *International Society for Ecological Economics (ISEE)*, November 15-19, Santiago de Chile.
---------- and Schmidt-Bleek, F. 1999. "Dematerialisation, MIPS and Factor 10. Physical Sustainability Indicators as Social Device." *Ecological Economics*. 29 (1): pp. 53-56.

Hurtienne, T. 1986. "Fordismus, Entwicklungstheorie und Dritte Welt". *Peripherie*. 6 (22/23): pp. 60-110.
--------- 1989. "Theories of Development, Differentiation of the Periphery and Development Strategies of the NIC's." In: *Political Regulation in the "Great Crisis."* Ed. W. Väth. Berlin: Edition Sigma, pp. 191-236.

IBRD 1992. World Development Report 1992. Oxford: Oxford University Press.

Jänicke, M. et al. 1992. *Umweltentlastung durch industriellen Strukturwandel*, Berlin: Edition Sigma.

Jessop, B. 1992. "Fordism and Post-Fordism: A Critical Reformulation." In: Pathways to Industrialisation and Regional Development. Eds. Storper, M. and Scott, A.J., London: Pinter.

Lipietz. A. 1987. Mirages and Miracles: The Crisis of Global Fordism. London: Verso.
---------- 1992. Towards a New Economic Order. Post-Fordism, Ecology and Democracy. Oxford: Oxford University Press.
---------- 1997. Developments and Alternatives: Hopes for Post-Fordism. In: Eds. Tylecote A. and Staaten, J. van der pp. 206-225.

Lipschutz. R.D. and Mayer, J. 1996. Global Civil Society and Global Environmental Governance. The Politics of Nature from Place to Planet. New York: State University of New York Press.

Lundvall, B. A. (ed.) 1992. National Systems of Innovation. Toward a Theory of Innovation and Interactive Learning. London: Pinter.

Matthews, E. et al. 2000. The Weight of Nations. Material Outflows from Industrial Economies. Washington, D.C.: World Resources Institute (WRI).

Martinez-Alier, J. and O'Connor, M. 1996. "Ecological and Economic Distribution Conflicts." In: Eds. Costanza, R., Martínez-Alier, J. and Segura, O., pp.153-184.

Max-Neef, M. 1999. Human Scale Development. Conception, Application and Further Reflections. New York: The Apex Press.

Messner, D. 1997. The Network Society. Economic Development and International Competitiveness as Problems of Social Governance. London: Frank Cass.

Nelson. R.R. (ed.) 1993. National Innovation Systems. A Comparative Analysis. New York: Oxford University Press

Norgaard, R. B. 1994. Development Betrayed. The End of Progress and a Coevolutionary Revisioning of the Future. London and New York: Routledge.

O'Connor, M. et al., 1996. "Emergent Complexity and Procedural Rationality: Post-Normal Science of Sustainability." In: Eds. Costanza, R., Martínez-Alier, J. and Segura, O., pp. 223-248.

OECD 1992. Technology and the Economy. Paris: OECD.
---------- 1995. Sustainable Consumption and Production: Clarifying the Concepts. OECD Workshop, Rosendal, Norway, 2-4, July 1994. Final Report, Paris: OECD (mimeo).
---------- 1997. Economic Globalisation and the Environment. Paris: OECD.

Opschoor, J. B. 1992. "Sustainable Development, the Economic Process and Economic Analysis." In: Environment, Economics and Sustainable Development. Ed. J.B. Opschoor. Amsterdam: Association of Post-Keyenesian Studies/Wolters-Noordhoff Publishers, pp. 25-52.

---------- 1995. ”Ecospace and the Fall and Rise of Throughput Intensity.” *Ecological Economics* 15 (2): pp. 137-140.

Panayotou, T. 1993. Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development. Geneva: International Labour Office- ILO Discussion Paper 1.

Pearce, D. and Turner, R. K. 1990. Economics of Natural Resources and the Environment. Baltimore: The John Hopkins University Press.

Perrings, C. 1996. "Ecological Resilience in the Sustainability of Economic Development." In: Models of Sustainable Development. Eds. Facheux, S., Pearce, D. and Proops, J. Cheltenham, UK and Brookfield US, pp. 231-252.

Porter, M. and van der Linde, C. 1995. "Green and Competitive: Ending the Stalemate." *Harvard Business Review*. Fall 1995.

Prigogine, I. and Stengers, I. 1984. Order out of Chaos. Man's New Dialogue with Nature. New York and other: Bantam Books.

Reed. D. (ed.) 1996. Structural Adjustment, the Environment, and Sustainable Development. London: WWF-Earthscan.

Rees, W. and Wackernagel, M. 1994. "Ecological Footprints and Appropriated Carrying Capacity: Measuring the Natural Capital Requirements of the Human Economy." In: Investing in Natural Capital. The Ecological Economics Approach to Sustainability. Eds. Jansson, A.M. et al., Washington, D.C. and Covelo, California: Island Press, pp. 362-391.

Rostow, W. 1960. The Stages of Economic Growth. A Non-Communist Manifesto. Cambridge: CUP.

Sachs, W. 1993. Die vier E's. Merkposten für einen massvollen Wirtschaftsstil. *Politische Okologie*. 11(33): pp. 69-72.

Schmidt-Bleek, F. 1994. Wieviel Umwelt braucht der Mensch? MIPS - Das Mass für ökologisches Wirtschaften. Basel u.a.: Birkhäuser.

---------- et al. 1999. *MAIA – Introduction in the Material Flow Analysis According to the MIPS-Concept.* Wuppertal: Wuppertal-Institute and Basel: Birkhäuser .

Schurmann, F.J. (ed.) 1993. Beyond the Impasse. New Directions in Development Theory- London: Pinter.

Shafik, N. and Bandyopadhay, S. 1992. Economic Growth and Environmental Quality: Time-Series and Cross-Country Experience. Washington, D.C.: World Bank Working Papers WPS 904.

Spangenberg, J.H. (ed.) 1996. Towards Sustainable Europe. A Study for Friends of the Earth Europe. Wuppertal-Brussels: WIKUE.
---------- et al. 1997. "Environmental Space and Material Flow Analysis. The "Sustainable Europe" Approach to Sustainablility." http://www.wupperinst.org/joachim.html.
---------- and Schmidt-Bleek, F. 1995. Welche Indikatoren braucht eine nachhaltige Entwicklung? Wuppertal: WIKUE-Wuppertal Papers No. 48.

Stern, D.I. 1998. Progress on the Environmental Kuznets Curve? *Environment and Development Economics*. 3(May): pp.173-196.

Suri, V. and Chapman, D. 1998. Economic Growth, Trade and Energy: Implications for the Environmental Kuznets Curve. *Ecological Economics*. 25 (2): pp. 195-208.

Thompson, P. and Strohm, L. A. 1996. Trade and Environmental Quality: A Review of the Evidence. *The Journal of Environment & Development*. 5 (4): pp. 363-388.

Tylecote, A. and van der Straaten, J. (eds.) 1997. Environment, Technology and Economic Growth: The Challenge to Sustainable Development. Cheltenham: Edward Elgar.

UNCTAD 1995. Environment, International Competitiveness and Development: Lessons from Empirical Studies. The Policy State on Trade, Environment and Development. Geneva: UNCTAD.

Wackernagel, M. and Rees, W. 1995. Our Ecological Footprint. Reducing Human Impact on the Earth. Gabriola Island, BC, Canada and Philadelphia, PA, USA: New Society Publishers.

---------- 1997. Perpetual and Structural Barriers to Investing in Natural Capital: Economics from an Ecological Footprint Perspective. *Ecological Economics*. 20 (1): pp 3-24.
---------- et al. 1998. "Ecological Footprints of Nations, How Much Nature Do They Use" – How Much Nature Do They Have?" http://www.ecouncil.ac.cr/rio/focus/report/english/footpint.

WCED-World Commission on Environment and Development 1987, *Our Common Future. The Brundtland-Report*, Oxford and New York: Oxford University Press.

von Weizsäcker, E. 1994. Earth Politics. London: Zed Books (Second Edition).
---------- and Jesinghaus, J. 1992. Ecological Tax Reform. London: Zed Books.
----------, Lovins, A.B. and Lovins, L.H. 1997. Factor 4. Doubling Welfare, Halving Nature Consumption. London: Earthscan 1997.

Weterings, R. A. and Opschoor, J.B. 1992. The Ecospace as a Challenge to Technological Development. Rijswijk, The Netherlands: RMNO Publication No. 74.

Biographical Sketch

Edgar Fürst is Faculty Professor and Senior Research Fellow at the International Institute of Economic Policy (CINPE) at Universidad Nacional de Costa Rica. He has specialized in Ecological Economics for Sustainable Development in Latin America and has published about 30 articles and 5 books on various issues of socioeconomic development, economic policy, and globalization, international trade and environment.

Address:

Centro Internacional de Política Económica
para el Desarrollo Sostenible (CINPE)
Universidad Nacional
Apartado 555-3000
Heredia
COSTA RICA
Tel: + 506-262 2082 / + 506-2601600

Fax:+ 506-261 8733
e-mail: efurst@sol.racsa.co.cr;
efurst@una.ac.cr