

## ECOLOGICAL ECONOMICS

Hans G. Nutzinger  
Kassel University

### 1. FROM ENVIRONMENTAL ECONOMICS TO ECOLOGICAL ECONOMICS THE NOTION OF SUSTAINABLE DEVELOPMENT

During the last twenty years there has been a lively discussion about the need for limiting both the use of exhaustible resources and the pollution of air, water and soil due to emissions and immissions caused by economic processes. Major steps in this direction have been the report of the "Club of Rome" *Limits to Growth* (1972), the report to the U.S. President *Global 2000* (1980), and especially the "Brundtland Report" *Our Common Future* (1987). In this context, also a broad discussion on the application of economic instruments for environmental protection has emerged (see, with further references, Nutzinger, 1993).

However, debate on both market-oriented instruments - such as licences, "ecotaxes", liability rules - and the implementation of cost-benefit analyses to environmental issues basically remain in the context of traditional welfare economics. As important as these deliberations on applications are for many practical problems, especially if the excessive use of nature is due to artificially low or even zero prices, they do not exhaust the full range of ecological problems. The most eminent problem on which I want to focus in this paper is related to the question of ecological limits to growth and its consequences for both economic theory and the real economic process.

The problem itself is as old as economic theory. It was already Adam Smith who in his *Wealth of Nations* (1776) stated the need for an uninterrupted process of economic growth which he called the "progressive state" whereas already mere stagnation - the "stationary state" - would be "dull" (*Wealth of Nations*, I.viii. 43). A similar point of view was taken by David Ricardo in his *Principles* (1817). But already thirty years later, the last classical economist, John Stuart Mill, took in his *Principles* (1848) an opposite (and very modern) view: He devoted Chapter VI of *the Stationary State* exactly to the question of limits to the economic process. His remarkable analysis is worth quoting at some length:

"I cannot ... regard the stationary state of capital and wealth with the unaffected aversion though generally manifested towards it by political economists of the old school. I am inclined to believe that it would be, on the whole, a very considerable improvement in our present condition. I confess I am not charmed with the ideal of life held out by those who think that the normal state of human beings is that of struggling to get on; that the tramping, crashing, elbowing, and treading on each other's heels, which form the existing type of social life, is the most desirable lot of human kind, or anything but the disagreeable symptoms of one of the faces of industrial progress. It may be a necessary stage in the progress of civilization, and those European nations, which have hitherto been so fortunate as to be preserved from it, may have it yet to undergo ... But the best state for human nature is that in which, while no one is poor, no one desires to be richer, nor has

any reason to fear being thrust back, by the efforts of others to push themselves forward" (chapter VI, §2).

In contrast to traditional wisdom, the basic reason for Mill's criticism of unlimited growth is not the accumulation of wealth and the splitting of society into poor and rich classes, but rather - as we would say today - the question of *ecological limits to growth*:

"Nor is there much satisfaction in contemplating the world with nothing left to the spontaneous activity of nature; with every rut of land brought into cultivation, which is capable of growing food for human beings. Every flowery waste or natural pasture ploughed up, or quadrupeds or birds which are not domesticated for man's use exterminated as his rivals for food, every hedgerow or superfluous tree rooted out, and scarcely a place left where a wild shrub or flower would grow without being eradicated as a weed in the name of improved agriculture. If the earth must lose that great portion of its pleasantness which it owes to things that the unlimited increase of wealth and population would extirpate from it, for the mere purpose of enabling it to support a larger, but not a better or happier population, I sincerely hope, for the sake of posterity, that they will be content to be stationary, long before necessity compels them to it" (ibid.).

In contrast to his predecessors, John Stuart Mill rejects the notion of a stagnation of human improvement as a consequence of an economic stationary state. Against this belief he argues:

"There would be as much scope as ever for all kinds of mental culture, and more social progress; as much room for improving the Art of Living, and much more likelihood of its being improved, when minds ceased to be engrossed by the art of getting on ... Only when, in addition to just institutions, the increase of mankind shall be under the deliberate guidance of judicious foresight, can the conquests made from the powers of nature by the intellect and energy of scientific discoverers, become the common property of the species, and the means of improving and elevating the universal lot" (ibid.).

From this extensive quotation by Mill, we can easily learn the reason why the notion of "sustainable development", which was basic for the *Brundtland Report*, was meant as a just and ecologically tolerable compromise between the obvious needs in developing countries, the high level already achieved in most industrialized countries and the opportunities to be left to future generations. According to Pearce (1988) and Harborth (1991), in this report the notion of sustainable development was used in a rather ambiguous way; however, in the subsequent discussion it has been transformed more into the direction of *sustainable growth* by adding little by little the conventional wisdom that economic growth in developing countries would only be possible on the basis of a preceding growth in industrialized nations. In this way, the debates on the GNP (Gross National Product) as an insufficient measure of economic welfare as well as attempts by American and Japanese economists to replace it by modified concepts, such as NEW (Net Economic Welfare) or NNW (Net National Welfare), have been substituted by reformulating the notion of *sustainable development*. The underlying

argument can be sketched as follows: Even if we agree that for rich countries GNP is a very bad measure of welfare for both ecological and social reasons, we must confess that traditional GNP growth in poorer countries will still contribute to the well-being of the people living there. If we now combine this idea with the assumption that GNP growth in Third World countries is only possible on the basis of traditional growth in First World countries, then the undeniable needs of poor countries can be (and have been) taken as an argument for continuing GNP-growth in the industrialized nations. In this way, the original idea of a just and ecologically acceptable compromise between the three groups of actors, based on reduced, if not negative growth rates in industrialized countries in order to create room for development in the Third World and to ensure opportunities for future generations, has been more or less perverted into a new growth ideology in all countries, only embellished by some market oriented instruments for environmental protection.

For these reasons, David Pearce (1988) labelled the notions of *sustainable development* and *sustainability* as well as their applications such as *sustainable agriculture*, *sustainable industry*, *sustainable economic development*, and *sustainable societies* "the fashionable catchwords of the 1980s" (1988, p. 598).

In order to get a clearer idea what *ecological economics* is really about, I want to discuss shortly the main components of a reasonable, non-corrupted notion of sustainability.

## **2. A CLOSER LOOK INTO SUSTAINABILITY AND THE MAINTENANCE OF NATURAL CAPITAL**

### **2.1. SUSTAINABILITY, NATURAL CAPITAL AND JUSTICE**

If one tries to find a common denominator for all reasonable meanings of sustainability, there is one basic requirement: *Sustainability requires at least a constant stock of nature and capital, construed as the set of all environmental assets* (cf. Pearce 1988, p. 599).

In this context, there is a broad, but not universal agreement that *sustainable development* has to serve at least four central goals, namely:

- Justice to the socially disadvantaged
- Justice to future generations
- Justice to nature, and
- Aversion to risk arising from our ignorance of interactions between the environment and economy and society
- And from social and economic damage due to low margins of resilience to external "shocks" (cf. Pearce, 1988, p. 599)

Now, since the preservation of our stock of natural capital is central to the notion of *sustainability*, we can describe it more precisely as a stock of natural assets serving economic functions; these assets act as:

- Supply of natural resource inputs to the economic process - soil quality, forest and other bio-mass, water, genetic diversity etc.,
- A means of assimilating waste products and residuals from the economic process, e.g. oceans, lakes and rivers as waste-receiving media,
- A source of direct human welfare through aesthetic and spiritual appreciation of nature, and
- A set of life supporting systems - bio-geochemical cycles and general ecosystem functioning; in this context the *ozone layer* and the problem of *global warming* (or *greenhouse effect*) have gained actual importance.

As both man-made capital  $K_M$  and natural capital  $K_N$  contribute to human welfare, we can conceive the role of capital in the economic process as follows:

As Figure 1 shows, both  $K_M$  and  $K_N$  contribute directly to human welfare - as inputs to the economic process - and indirectly, as parts of the cultural heritage, to aesthetic experience as well as to local and global life support systems.

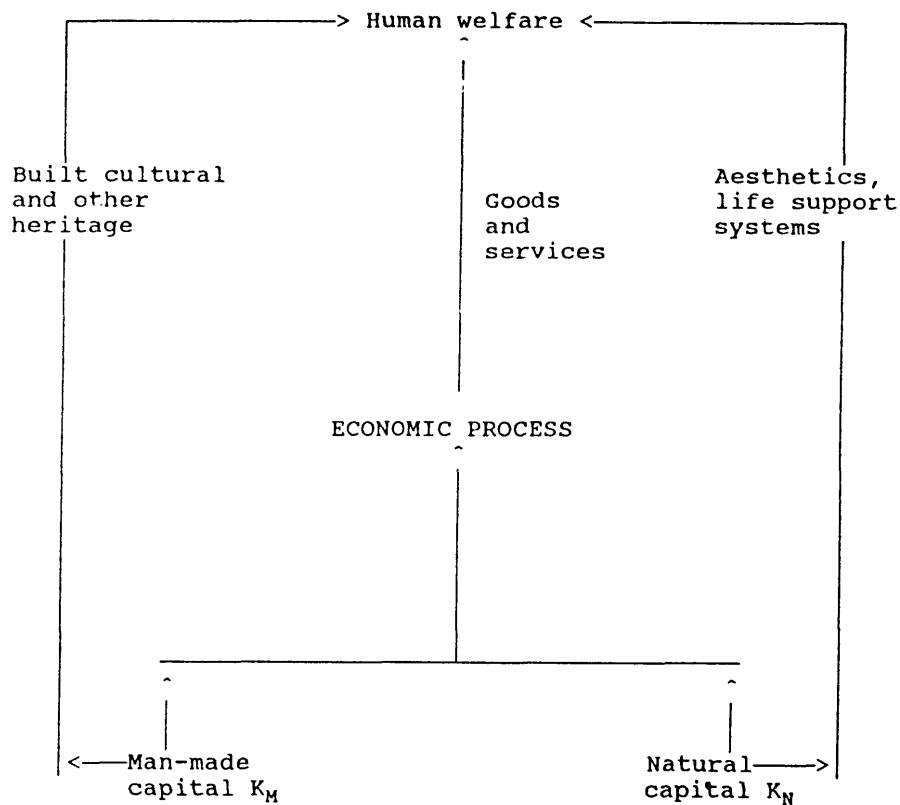
There are at least two different kinds of arguments for associating a non-decreasing natural capital stock with sustainability. If we equate sustainability with *durability*, then the basic reason for linking a non-decreasing  $K_N$  with sustainability is its function as a "buffer" in order to maintain or to increase the *resilience* of the economy to major shocks, such as climatic change, war and epidemics.

The prevailing literature, however, argues in favour of a sustainable economy for reasons of *justice*, especially "*intragenerational*" *justice* (to people within a generation), "*intergenerational*" *justice* (to people between generations) and "*justice to nature*", i.e. to non-human sentient beings.

In this context, there also seems to be a link between the sustainable development path and improvements in human welfare, so that three kinds of goals are assumed to be served by sustainable development, namely

- *Equity* (within and between generations, and to nature)
- *Survival* (durability as resilience), and
- *Welfare improvement* (rising average standards of welfare)

Here we clearly find an optimistic assumption underlying the sustainability discussion: That the basic social objectives on a sustainable development path are to be considered as *complementary*; however, since this will only be the case up to a certain point, the question of necessary *trade-offs* between these different goals have to be taken into account.



Source: Slightly modified following Pearce 1988, p. 600.

**FIGURE 1**  
**INTERRELATIONSHIP BETWEEN MAINTENANCE OF  $K_N$  AND  $K_M$**

**2.2. MAINTAINING NATURAL CAPITAL  
 SUBSTITUTABILITY OR COMPLEMENTARITY?**

In general, it is difficult to relate the maintenance of natural capital to different strata of society; but, at least for the mass of population in the poorest countries, there is a direct dependence on natural resources, such as firewood. In developed countries, the relationship is more ambiguous; however, according to Pearce (1988, p. 601), "the evidence does not favour the wide-spread view that the rich are willing to pay more for environmental quality in general".

If one equates the "next generation" with the "least advantaged member of society" one can extend Rawls' (1971) "maximin strategy" into an argument for the claim that the next generation should have access to at least the same resource base as the previous one. The problem with the application of this rule is that it is difficult to construct a "veil of ignorance" as an argument for risk aversion and the choice of a "maximin strategy" because everybody living today has good reasons to assume that he will not be a member of the next generation. So, the argument could only relate to the "veil of ignorance" concerning the position of people's children as members of the following generation. In this way, it could become possible to convince the present-day generation to pursue a maximin strategy in the interest of their offspring.

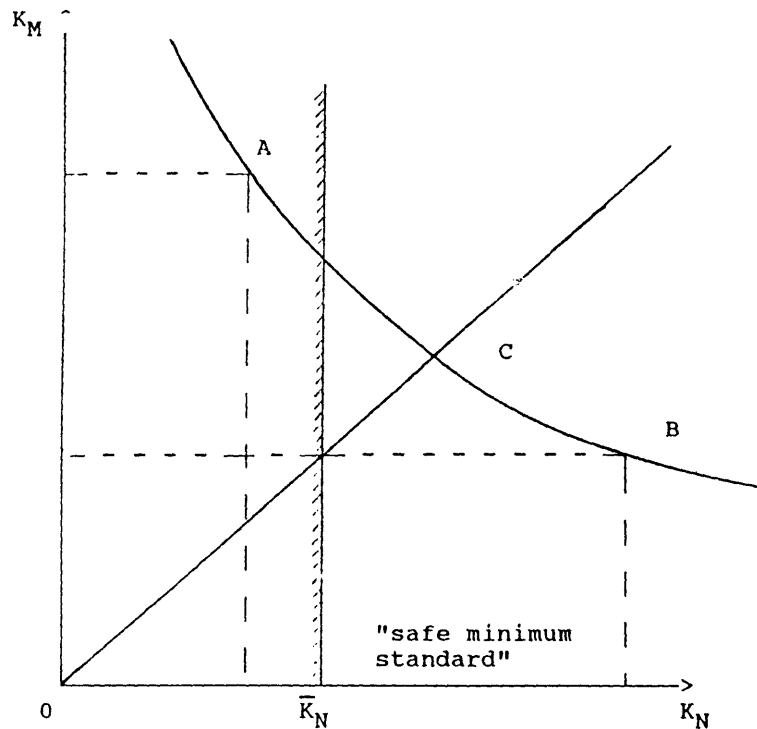
In any case, we need a specific reason if we primarily argue for the maintenance of natural - and not so much of man-made - capital. One reason for that could be that natural capital is "basic" to the economic process and hence, in Rawls' terms, a candidate for a "primary" good with the characteristic that any rational being would always prefer more of it to less. Whereas it is relatively easy to change the size and structure of man-made capital, this is probably difficult, if not impossible in the case of natural capital which is subject to serious *irreversibilities*. If we attribute the "primary" and "irreversibility" characteristics to  $K_N$  (and not to  $K_M$ ), then both kinds of capital are *substitutes only up to a certain point*, and therefore preserving natural capital, especially the life support functions of the natural environment, seems more fundamental as it is a necessary precondition for the ability of choice as such. Therefore, natural capital as a precondition for the ability to choose might be given higher weight than the short-run act of choosing between natural and man-made capital.

As far as the rights of non-human sentient beings are concerned, there is a clear and obvious argument against any decrease in natural capital: The greater the stock of natural capital, the greater the habitat which can be occupied by wildlife is likely to be, and this in turn seems to be more consistent with genetic diversity than any consequences of reduced natural capital for wildlife.

As both man-made and natural capital permit resilience to economic impairments by external or cumulative shocks, any priority given to the maintenance of natural capital needs some justification. Again, a reason for this could be seen in the "primary" and "irreversibility" characteristics of natural capital; in addition, especially in developing countries, the application of man-made capital (such as machines, artificial fertilizers etc.) is subject to severe limitations, due to a lack of adequate human capital, logistics and hard currency.

As far as the relation between man-made and natural capital is concerned, there are, as already stated above, arguments for both complementarity and substitutability. But it is reasonable to assume that the complementarity arguments seem to be stronger for the poorer countries. In Figure 2, a move from O to C might typify an arid area in need of soil and water conservation and of grazing land rehabilitation. In contrast, a move from C to A could be considered as a rich society's choice between land development and habitat conservation.

In the past, undoubtedly, the maintenance of man-made capital was given higher weight than natural capital preservation; this can be mainly explained by the neo-classical argument that the price of natural capital was artificially low compared with the price of  $K_M$ , resulting in an over-utilization of natural capital and a lack of its preservation. Another reason for the bias against natural, and in favour of man-made, capital has been the multi-functional character of natural environments. As long as the pervasiveness of the benefits of preserving and augmenting natural capital has not been understood completely, cost-benefit analyses tended to undervalue the rates of return on investments in natural capital. However, if one includes the full range of benefits of the many functions of natural capital, then economic rates of return on investment in natural capital can be of the same size as return rates to "harder"



Source: Pearce 1988, p. 603.

FIGURE 2  
 $K_N$  AND  $K_M$ : COMPLEMENTARITY VS. SUBSTITUTABILITY

investments, such as factories or power plants.

Even if there are neoclassical choices among  $K_M$ - $K_N$  isoquants, some minimum capacity (*carrying capacity*) has to be taken into account which can be determined in relation to the number of people that can make their sustainable living on the basis of existing or projected resources. In this case, only choices to the right of  $K_N$  can be permitted. We could consider  $K_N$  as a definition of the *safe minimum standard*. This *carrying capacity* can be increased by man-made capital as well as by natural capital, and hence it might change over time.

If we want to summarize the results of this section, we can say that the notion of "sustainable development", based on a non-decreased, natural capital stock, is a promising starting point for a definition and empirical application of *sustainability*. In this way, also the misuse of this notion indicated at the beginning of this section could be easily shown. In this context, growth is no longer an end in itself but rather a possible event of the economic process which should take place in a strict economic frame order; and within such an economic system, the potential for high growth rates has vanished.

### 3. MAIN AREAS OF ECOLOGICAL ECONOMICS

#### 3.1 RELATIONSHIP BETWEEN ECOLOGICAL AND ECONOMIC SYSTEMS

In a first approximation, one can say that *ecological economics addresses the relationships between ecological systems (ecosystems) and economic systems* in the broadest sense. As many of our most urgent problems - such as global warming, species extinction, acid rain, deforestation, soil erosion and uneven wealth distribution - are embedded in these relationships, they cannot be analyzed sufficiently within the frame of one single discipline. The main components of *ecological economics* - namely *environmental and resource economics* (of the neoclassical variety) and *ecology* as analysis of "natural systems" without due regard to human impacts on them - clearly do not cover adequately the important *interrelationships* between both kinds of systems. One could also say that *ecological economics* is concerned with problems arising from the *embeddedness* of the economic system in different types of ecosystems. Therefore, it will not be sufficient just to add up economics and ecology: Whereas *ecological economics* must include both neoclassical environmental economics and ecological impact studies as parts, it has to encourage and find new ways of thinking about the linkages between ecological and economic systems (cf. Costanza 1989, p. 1).

Obviously, there is a very high claim involved in this general definition of *ecological economics*: In a sense, it presupposes some kind of a *holistic* approach considering economic and ecological systems as a *whole*, while at the same time, in a more concrete analysis, ecological economics is forced to focus on certain aspects of this totality. Nevertheless, the focus on the *interrelationships* between the different systems should always be kept in mind, even though only certain parts of the problem have to be considered. In order to illustrate this issue, one can, for instance, define a neoclassical optimization model in order to calculate the "shadow prices" of natural resources and of environmental destruction; these imputed prices clearly reflect, inter alia, the external limits prescribed for the use of natural resources (including assimilative capacities). Now it will not be sufficient just to infer those limits from ecological considerations; in addition, the structure of the economic system has to be modeled in a way which also includes the interrelationship between the economic variables (such as the production process) and the ecological key factors. The widely used separation of the external ecological frame order and the economic process going on within this structure is only a very rough and first approximation to the problem.

Having defined the intention and claim of *ecological economics* in this general sense, I would like to have a closer look at some of the most important fields of research.

#### 3.2 ETHICAL FOUNDATIONS OR THE WAY HOW WE PERCEIVE THE PROBLEM

Traditional economists tend to be overly optimistic with respect to market forces, substitutability, and economic adjustments. A typical neoclassical economist might be inclined to see the whole problem of environmental pollution as a result of insufficiently defined and specified private property rights with regard to natural resources. According to this view, most ecological problems are just a consequence of



wrong prices which in turn are caused by undefined or inefficient collective property rights. Furthermore, the problem of these exhaustible resources will be resolved whenever it occurs because scarce supplies will result in rising prices, giving incentives to economizing, to technological improvements, to substitutes and, above all, to innovative processes based on profitable research and development. In the long run, even the problem of population growth will be overcome through the economic process itself: The creation of wealth to more and more people on earth will give them incentives to reduce the number of their offspring.

Of course, as mentioned above, this view is overly optimistic. During a long period or time there might be an *inverse* relationship between current prices (on spot markets) and long-run scarcity due to the fact that current prices tend to reflect much more a short-run oversupply on the basis of forced extraction than an increase in long-run scarcity caused by this intensive short-run extraction policy. After some time, however, at least as we approach the physical bounds, even current prices will reflect these limits via steep price increases, but we cannot be sure that the incentives created by those dramatic price jumps will in every case create exactly that kind of new technology - the "backstop technology" - that is needed in order to overcome those physical limitations. Admittedly, traditional ecologists on the other side tend to underestimate the built-in flexibility of the economic system, and this was one basic criticism against the report *Limits to Growth* (1972). Nevertheless, a simple game theoretic consideration of the issue reveals that a reasonable "game strategy", based on the "maximin rule" already mentioned, must lead to policy implications quite different from those pursued today. If we consider Figure 3, we have a stylized picture of different strategies under the assumption that we do not know whether (neoclassical) optimists or (ecological) pessimists are right.

Cur- rent policy	Real state of the world	Optimists right	Pessimists right
Technological optimist policy		High outcome	Disaster
Technological pessimist policy		Moderate outcome	Tolerable outcome

Source: Costanza, 1989, p. 4.

**FIGURE 3**  
**PAYOFF-MATRIX FOR TECHNOLOGICAL OPTIMISM**  
**VS. PESSIMISM UNDER UNCERTAINTY**

In this situation, it is indeed very tempting (and we have succumbed to this temptation) to pursue the technological optimist policy which promises high rewards *if the optimists are right in their perception of the real state of the world*. The "maximin rule", however, requires that we pursue a policy whose worst possible result is a preferable outcome to the worst outcome under another policy. As the optimist's technological policy leads to a disaster, if the pessimist's perception of the world is correct, we have to give up this policy altogether and should instead switch to the technological pessimist policy whose worst outcome ("tolerable") is clearly preferable to the "disaster" result of the first strategy. The "optimal" strategy hence, can be derived as follows: If we *really* do not know the state of the world, then we should choose the policy that is the maximum of the minimum outcome. This means in our simple case that we have to give up field (1,1) in Figure 2 and instead move to field (2,2). As long as we do not have clear reasons for being overly optimistic - the often quoted fact that we were able to avoid disasters in the past is certainly not sufficient for mastering the future - we should pursue a cautious "pessimist policy". This has clear implications for dramatic changes of economic policy both at the national and the international level.

If one compares the enormous technological possibilities of today's generation with those of the past, and looks at the same time, at the associated and possibly dramatic risks for future generations, then it becomes clear that the problem of responsibility cannot be solved solely by the economic process and the imputation of prices. Responsibility, especially with regard to Third World people and to future generations, then becomes the central ethical problem of both theory and practice of *ecological economics*. For that reason, David Pearce (1987) has argued for applying a Rawls-style concept of distributive justice in the context of different generations. The Rawlsian "veil of ignorance" then relates to uncertainty about that generation to which one belongs. As the neoclassical assumptions of sufficient flexibility, substitutability, and speedy adjustment are not necessarily fulfilled, a mere reliance on market forces seems to be inappropriate. But if we try to embed the economic process into some ethical frame order (as an indicator of the underlying ecological systems and of the ignorance about some important interrelationships), then we have to justify our ethical restrictions as far as possible in order to make them theoretically acceptable and politically applicable. In fact, what we are facing is basically the "true uncertainty" in the sense of Frank Knight (1921).

### **3.3 MAJOR ISSUES AND AIMS OF ECOLOGICAL ECONOMICS: AN ANNOTATED LIST**

Starting from our definition that ecological economics is concerned with the inter-relationship between ecosystems and economic activity (cf. Proops 1989, p. 60), we can perceive central problem areas in the following fields:

#### **(1) ESTABLISHING A HISTORICAL PERSPECTIVE ON INTERACTIONS BETWEEN SOCIETY AND NATURAL SYSTEMS**

In order to understand our present local, regional and global problems, we have to reconsider the industrialization process which spread from Britain to

Continental Europe, and later on to North America and Japan; present global problems, such as the global warming due to carbon dioxide and other gases, have their deep historical roots exactly in this process. As Martinez-Alier (1987) has shown, the presently discussed "greenhouse effect" was already under investigation about one century ago as "*Glashauswirkung*" (which is nothing but an older German name for the same kind of problem).

(2) **FINDING A COMMON LANGUAGE**

The underlying definition of ecological economics implies close interdisciplinary work between economics and other social sciences on the one hand and natural sciences on the other hand. Therefore it is of utmost importance to find a common language and a common set of concepts for analysing economics and ecosystems.

(3) **ADAPTATION OF NATURAL SCIENCE APPROACHES**

Beyond a common language and a common set of concepts, ecological economics also needs a well-defined area of intersection between natural science and social science (cf. Proops 1989, p. 61) where methods and views from both natural and social sciences have to be combined; for instance, the applicability of the physical theory of *open systems* to economic and ecological systems has to be considered in more depth (for this, see the thesis by Mathias Binswanger, 1992).

(4) **POLITICAL IMPLEMENTATION AS PART OF THE ISSUE**

As mentioned above, ethical and political issues are of central importance for the theoretical foundations of ecological economics and its application to practical issues. Given the fact that most global problems have differentiated impacts on various regions and countries and that there is an increasing gap in wealth between First World and Third World countries, *ecological economics must be concerned with the development of "packages" acceptable to all parties involved*. This means, *inter alia*, that even aspects of economic development have to be taken into account. For instance, a worldwide agreement against the global warming (greenhouse effect) will only be possible if the industrialized nations who are responsible for about four fifths of the relevant carbon dioxide and other gas emissions are willing to give financial and technical aid to Third World countries which in turn will enable them to pursue a less energy-intensive industrial development which is less harmful to the atmosphere. By the way, in this case it is not quite obvious whether this aid is to be considered as a *transfer* from the North to the South or as a *compensation* payment from the industrialized countries for their historical over-utilization of the atmosphere during the last two centuries.

**4. OUTLOOK AND PERSPECTIVES FOR ECOLOGICAL ECONOMICS**

**4.1 THE STIMULUS FOR FUTURE ACTIVITY**

This list of problem areas is by no means exhaustive; other central questions relate to

the foundations and the practical consequences of ethical analysis of intra-generational and inter-generational choices: Since Adam Smith's *Wealth of Nations* (1776) at the latest, economics has ceased to be just a field of applied moral philosophy. Therefore, a traditional Aristotelian "dictatorship model" of ethics is no longer acceptable in this field. Furthermore, it is also necessary to acknowledge the fact that the maintenance of justice in a formal sense and the imputation of costs via competitive prices is not sufficient, given the extent of ecological problems on the one hand and the fact that *ecological systems have to be considered not only as factors of substitution but also as life support systems* (cf. Costanza/Daly 1987, p. 2-3).

The short annotated list of basic problems within ecological economics has made clear that there is a vast field of future interdisciplinary work. Considering this enormous task one might wonder whether there is enough stimulus for researchers and research in this field. Following Proops (1989, p. 63-65) one can identify the following sources for increased theoretical and practical activity in this field:

- (1) There is a growing perception that things will go on getting worse unless we undertake severe changes both in economic theory and economic policy. We have to find a reasonable line between an exaggerated doomsday lamentation on the one hand and an unjustified and naive optimism and belief in the self-healing forces of the economic process itself on the other hand; as different as their arguments might appear, as close are their results, namely a dangerous inactivity and an incorrect "laissez faire, laissez passer" approach (either because nothing can be done any more or because nothing needs to be done).
- (2) Another ethical stimulus of ecological economics can be seen in Kant's perception of morality as being an objective requirement, independent of what anyone may want (cf. Proops 1989, p. 63). Kant's "categorical imperative" can be extended into an "ecological categorical imperative": His idea that man should never be considered as mere instruments can be extended to the nonhuman outer world as the natural basis of human life today and in the future; the Kantian idea of mankind (*Menschheit*) implies in principle all human beings at all times. To put it in other words: In building up modern industrialized states, humans have squandered away natural riches and have abused the implicit contract with past and future generations to act as stewards over the natural world (cf. Proops, p. 64). As humans no longer live in harmony with nature, they also do not live in harmony with themselves. Therefore, the ecological categorical imperative can be considered as an obvious extension of Kant's original view.
- (3) The traditional and partly still unresolved problems of economic development and social justice have to be seen now in a broader ecological context: The notion of sustainability of social, economic and ecological systems has become central for the analysis of "*Our Common Future*" (Brundtland Report 1987). In a way similar to the social movement of the 19th century, ecological economics can be considered as a "revolutionary" activity which attracts growing awareness in industrialized countries both from intellectuals and the population at large. On the basis of the struggle for short-term survival in many Third World countries, it becomes clear that this ecological awareness will only be possible on a global

level if conditions for short-run survival are established on a worldwide level. Therefore, ecological problems and problems of social justice in the context of First and Third World countries are closely interrelated (cf. section 3.2 above).

- 4) Ecological economics is opening up new world views. This means for economic analyses that the biophysical foundations of economic-systems have to be recognized not only on the level of a changed economic policy but also of a changed perception of economic modelling. Here we are only at the very beginning of a re-orientation. What is needed now is especially a kind of "double strategy": On the one hand, we must try to come to practical recommendations for a changed economic policy on the basis of more or less traditional neoclassical models (which are mainly attempted in the field of *environmental and resource economics*). In addition to that, also new perceptions and new models integrating physical, biological and economic interrelationships have to be developed in order to come to more appropriate ecological foundations of economic reasoning.

#### 4.2 OUTLOOK AND FURTHER PERSPECTIVES

Ecological economics has only evolved during the last three decades. Considering both theoretical claims and practical needs, it is far from being sufficiently developed, although some major steps have been taken by people such as Georgescu-Roegen, Daly, Pearce, Costanza and others. Its further development should not only be dictated by urgent needs of practical policy (such as the protection of the ozone layer, the handling of the greenhouse effect etc.) but also by a reorientation of our views of the world and of our utopias and visions of a better world. This is a vast field, and one might be tempted to present a list of wishes to an ecological "Santa Claus"! I would like to conclude at this point that we must give up the basic idea of Adam Smith's *Wealth of Nations* (1776) that human welfare and human wealth in the sense of an ever increasing amount of goods and services can be reasonably harmonized with the requirements of long-run sustainability. The old Aristotelian idea of a "good life" has to be re-detected whereby one must have in mind that, depending on the respective wealth level" the ideas of a "good life" will vary considerably among different countries and regions. Especially if we acknowledge that more goods and services are still a welfare improvement for the poorest countries, then we must be willing to limit our own growth in traditional wealth and to grant them substantial technical and financial aid in order to create ecological room for increased production (and hence, in many cases, also for increased use of energy) in those countries that are still in bitter need of the traditional wealth model.

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