We are IntechOpen,
the world's leading publisher of
Open Access books
Built by scientists, for scientists

6,900
Open access books available

186,000
International authors and editors

200M
Downloads

154
Countries delivered to

Our authors are among the

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities

CLARIVATE ANALYTICS

BOOK CITATION INDEX

INDEXED

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

Three Totally Different Environmental/GDP Curves

Leif Bratt

Cemus – CSD Uppsala, Uppsala University
Sweden

1. Introduction

When one wants to communicate there are rhetorical suggestions that will increase one's chances to succeed in convincing the other part. If an easy, intelligible and ultimately elegant model to explain a phenomenon is presented, the chances to reach deeper into the centre of perception of a recipient will increase, compared to wrapping the same thing in perhaps more exact mathematical formulas. To make a point, one of the more complex explanations I have come across, when it comes to environmental-economic relations, is from Perrings dealing with long term sustainable development and biodiversity. It will probably elucidate what I mean. He says;

If $\#K_j(t+s) < \#K_i(t)$ and $f(K_j(t+s)) \succ f(K_i(t))$ there exists an opportunity set $K_i'(t)$ such that $\#K_j(t+s) = \#K_i'(t)$, with $f(K_i(t)) \in K_i'(t)$. By the axiom of weak independence $f(K_j(t+s)) \chi K_i'(t) \setminus f(K_i(t)) \succ f(K_i(t)) \chi K_i'(t) \setminus f(K_i(t))$, and by the axiom of focus, $f(K_j(t+s)) \chi K_i'(t) \setminus f(K_i(t)) \sim f(K_j(t+s)) \chi K_j(t+s) \setminus f(K_j(t+s))$. It follows that $f(K_j(t+s)) \chi K_i'(t) \setminus f(K_i(t)) \sim K_j(t+s)$, and by transitivity of $\succ K_j(t+s) \succ f(K_i(t)) \chi K_i'(t) \setminus f(K_i(t))$. Let $K_i''(t) = K_i(t) \setminus K_i'(t)$. If there exists $K_h(t+s) \sim K_i''(t)$, then by the axiom of focus $K_j(t+s) \chi K_h(t+s) \succ f(K_i(t)) \chi K_i'(t) \setminus f(K_i(t)) \chi K_i''(t)$. Hence, $K_j(t+s) \chi K_h(t+s) \succ (K_i(t))$. The proposition states that a sufficient condition for sustainability of a reachable opportunity set that does not offer the same freedom of choice as the current opportunity set is for that set to be augmented by a range of choice of equal size and (present) value to that lost from the current opportunity set. (Perrings 1989 p 108)

From the context one can understand that he tries to say that natural resources have to increase over time if we shall be able to talk about development in the sense of progress. If they are kept at a constant level we can only reach a stationary state of the economy. The above is a mathematically totally correct picture of the situation. The problem might be to find the correct values for all components of the equation.

Another way is to lessen the factors in the argumentation. But the down-side of minimalism is often that one reduces or hides parameters that could influence the outcome. So there is a trade-off between ease of communication and 'full' understanding. But simplicity is obviously a 'trick' to facilitate the possibility of reaching the opponent's ears. If one can present credible arguments that *a* causes *b* it is much easier than trying to start with the all the considerations of reality. So in all scientific textbooks we can very often find the interaction or relationship between two parameters presented as a graph in a diagram with

284

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

two axis. The literature of Sustainable development and Sustainability is no exception (Dearing 2007). Here we can find a lot of environmental curves which the authors use to ease the transferring of 'knowledge'[1]. Coarsely they can be divided into two major clusters. The environmental 'real world' curves and the environmental 'causative' curves. The former are diagrams with 'real' figures and normally with a spatial or temporal x-axis. Examples are the degradation of the ozone layer against latitude and the CO_2 concentration in the atmosphere over time. The second group uses the x-axis trying to find the effect *a* has on *b* and from there a cause to environmental improvement or deterioration.

One of the most well-known and straight-forward of this second group is the so called Environmental Kuznets Curve (EKC). It contains the two parameters Gross Domestic Product (GDP) and environmental 'problems'. The purpose is to explain what will happen to the environment when income in a country changes. With a World Bank report from 1992 that used an Organization for Economic Co-operation and Development (OECD) report from 1991 as its foundation, creative economists has presented the inverted U-curve as the 'liaison' or the explanation to environmental problems and how to solve them – more growth. But with different environmental discourses (Dryzek, 1997) due to different pre-analytic vision there are people who look at this relationship in a different way. The EKC has been challenged by 'environmentalists' who use the concept of limits to growth as the starting point. By using the same parameters and their own arguments and/or findings a more or less exponential curve has been the result. I have chosen the term Environmental Daly Curve (EDC) as a connotation for this graph. But if one reads the World Commission on Environment and Development's report *Our Common Future* (WCED 1987) or as it is also called the Brundtland report from 1987 and exercises the same categories and a little bit of creativity one can generate a contradictory curve compared to Kuznets' curve, a nearly upright U which I will call the Environmental Brundtland Curve (EBC). As I wish to be pedagogic the text is here presented graphically with Gross Domestic Product (GDP) as x-axis and environmental 'problems' as the y-axis.
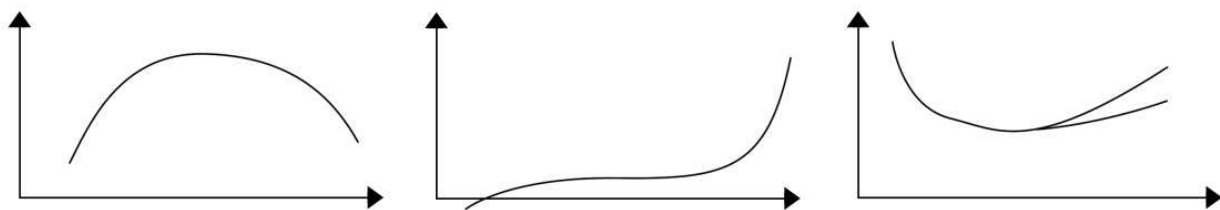

Fig. 1. Three different environmental curves. From left EKC, EDC and EBC

So in the 'value free' scientific world we now have three different curves who all claim they have the 'right' explanation to what economic growth does to the environment in the end – a benign, malign or problematic result on the ecosphere respectively.

Logically it seems impossible that they all can be right. But could they all partly be on the 'true' track? Could it be that they unintentionally use spatial, temporal or political limitations and from these particular findings make (wrongly) general conclusions? The purpose of the study is to see if there is a possibility to reach some sort of reasonable standpoint.

---

[1] The most famous ones are probably the graphs presented in Meadow's *The limits to growth* created from their computer-based *World3*-model (Meadows et al., 1972).

1.1 Methodology

The theoretical and scientific frame-work for this essay is actor theory and more specific the model of professor Söderbaum (Söderbaum 2008) which says that humans prefer to find answers that are consistent or compatible to their existing worldview or ideological orientation. They more easily accept facts that strengthen their beliefs they already have.

The Environmental Kuznets Curve concept (GDP and environmental 'problems' as the categories) will be the analytic tool. The model originates from the American economists Simon Kuznets who found that economic inequality changes with economic development. With income per capita as the x-axis and inequality as the y-axis, the relation takes the form of an inverted U. First inequality increase with income but after a certain level it is decreasing. Some economists saw the same relation (the inverted U) between environmental stress and income and named it (due to its similar appearance) the *Environmental* Kuznets Curve. So with these two categories (environmental stress and GDP) I will investigate what sort of correlation other scholars have found. From the arguments in the Brundtland report and Ecological Economic literature I will draw an Environmental Brundtland- and an Environmental Daly Curve respectively, and then compare the three of them with empirical findings. This will be supplemented with results from other authors and by using their arguments in a discursive analysis structure. The ambition is to find out what the different curves tells us about sustainability in connection to economic growth

1.2 Definitions

Environmental stress. As the study scrutinizes a lot of literature it could be that a particular author uses the concept in his/her own way, but in my opinion it is understood as nuisances in the ecosphere. In the case of EKCs with GDP as the x-axis I think it is fair to limit the concept to unnatural levels of 'waste' in the ecological system (Radetzki 1992).

Gross Domestic Product. It is meant to be the value of the production of goods and services in a country that is traded on a registered market at the end-user level. The contribution from the public sector is their salaries. As explained below this concept could be calculated in three different ways. They are supposed to come to the same result in monetary terms, but the content is totally different. It must also be mentioned that when written, GDP is understood as per person in a country.

2. Environmental curves

The WCED report put forward a number of what they call 'strategic imperatives' as a guideline for humanity if we wish to enter the path toward sustainable development. One of them is a renewal of continuous economic growth. This is, according to the same report, conditional to our capability to enhance the resource base and reorienting technology for better efficiency without further erosions of planet Earth's ecosystem so that it can continue to be the source of progress upon which development depends. This thread of a connection between the environment's capacity and the wish for economic progress is as old as political economy. Malthus, Ricardo and Mill all, but for different reasons, discussed the problem and saw limitations (Daly 2007; Hermele 1995; Pearce 1993). In the 1960s and 70s, advocates for different world-views or stakeholders tried to articulate arguments to convince the audience that the equation between economic growth and a continuous flow of resources

from the ecosphere is feasible and perhaps even more important, trustworthy. Others struggled to show that it is an impossibility (Andrén 2004; Cherni 200;, Mäler 1993). There are even groups who see a viable economic system with continuous growth as a prerequisite for a 'living' ecosphere or solving the problem (Andrén 2004; Booth 2004; Friman 2002; Stern Internet).

The starting point of the discussion about growth and environmental relations and the following political process was the experiences of development side-effects in the 1960s. One of them was the so called "acid rain" due to the use of fossil fuel with high sulphur content that was used as a source for energy. Economical interests (forests and man-made constructions) were at risk (Porter 2000). So the first step was to increase the height of the chimneys to 'put' the unwanted material higher up in the atmosphere to decrease concentration. But it also meant that neighboring nations, down-wind, had to pay a price (Porter 2000). So now "acid rain" was an international issue and the real background why Sweden (down-wind) pushed so hard for an international environmental conference under the supervision of the UN. Politicians acted due to economical reasons (WCED 1987) and perhaps also the thought that the realization that the new environmental consciousness that emerged during the 1960s could result in votes in the next election. When one looks at the following negotiations between states it is hard to find any coupling between high GDP, environmental awareness and the proponent for reduction of the emissions. During the talks, the United States and the United Kingdom (countries with high GDPs) opposed official pledges of emission cutbacks. And as Porter continues "The protocol came into force in September 1987, but it lacked the adherence of three major exporters of acid rain: the United States, the United Kingdom, and Poland, which together represented more than 30 percent of total world emissions of sulfur dioxide." (Porter 2000) But could they get any support from the scientific world?

2.1 The Environmental Kuznets curve

The Word Bank's annual Development report from 1992 has the subtitle *Development and the Environment*. Here they present their view on the status of the human environment – both the natural surroundings and the living standard. There were 6 graphs. Fig 2 is just one example of the two inverted U's presented. Their findings are mainly based on the OECD report *The State of the Environment* from 1991. Note that the original has absolute numbers on the y-axis and a logarithmic scale as the x-axis.

The empirics presented were used by some economists as an inspiration to explain that GDP at a high level was beneficial not only to better living conditions but more important to the natural environment in general (Brännlund & Kriström, 1998; Dasgupta, 1994, Grossman & Krueger, 1995; Mäler 1993; Panayotou 1993; Vogel, 1999). The main support of this view has come from proponents of the free market as the best solution for an ever increasing standard of living. They argue that a free market will provide increasing economic growth as the mean for higher and higher welfare. Representatives from this group will be found in the larger companies and in the political establishment. They either make more profit or get more room for political reforms by higher GDP. And then it is hard for them to see that their mean (GDP) could be harmful to environment. A collective "label" for these actors is "Business-as-usual". They want the socio-economic foundation to be unchanged. They like it as it is.
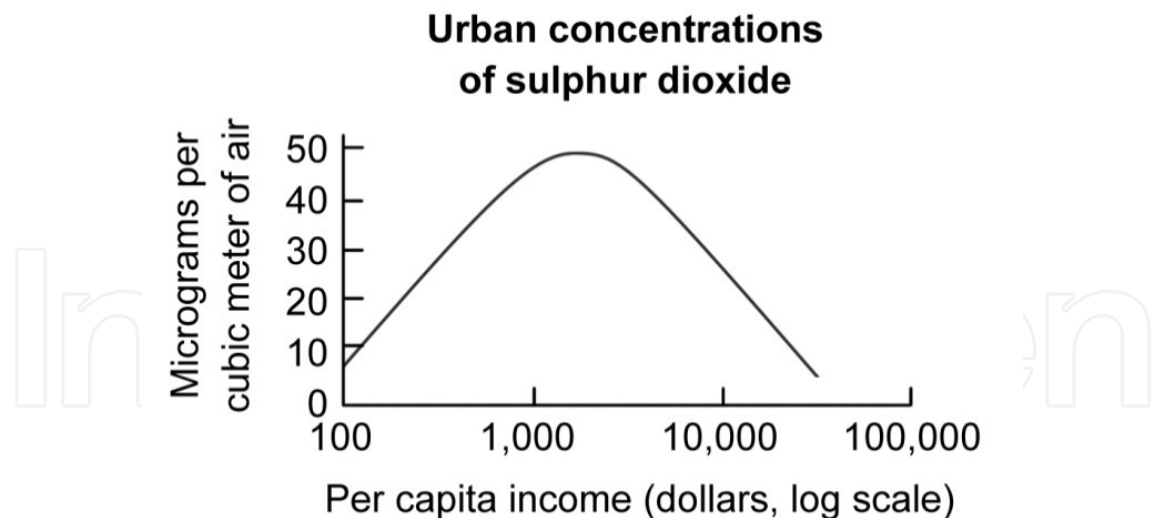
Urban concentrations of sulphur dioxide

Fig. 2. The World Bank graph. Source: World Bank 1992

The curve became one pro-argument for 'Business-as-usual' to be sufficient, to explain how economic growth is not only compatible to a 'green' future but even could be instrumental to an improvement of the ecosphere, that they are mutual reinforcing. Stakeholders for this group presented a theory or graph that was baptized as the Environmental Kuznets Curve (Fig. 3).

According to this, where the x-axis is the economic activity measured as GDP and the y-axis is environmental stress, measured as unwanted substances in the environment, ecosphere problems presented graphically take the shape of an inverted U, i.e. that it is the mid-income countries who have the most negative impact on the environment (Booth 2004, Daly 2007, Mäler 1993). The father of the concept, Panayotou gives the 'logical' explanation:

 "At low levels of development both the quantity and intensity of environmental degradations is limited to the impacts of subsistence economic activity on the resource base and to limited quantities of biodegradable wastes. As economic development accelerates with the intensification of agriculture and other resource extraction and the take off of industrialization, the rates of resource depletion begin to exceed the rates of resource regeneration, and waste generation increases in quantity and toxicity. At higher levels of development, structural change towards information-intensive industries and services coupled with increased environmental awareness, enforcement of environmental regulations and higher environmental expenditures result in leveling off and gradual decline of environmental degradation." (Panayotou 1993 p 1)
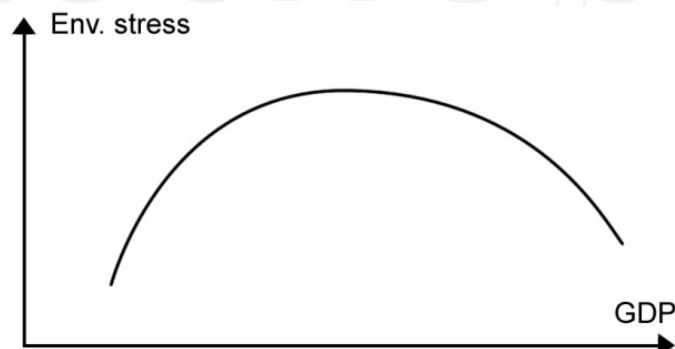
Fig. 3. Environ. Kuznets Curve EKC

288

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

But his conclusion about the causes of less impact on the environment is aggregated to or interpreted as, one single cause – economic growth. Two other pioneers, Grossman and Krueger, say in their article quite unconditionally that;

…we found no evidence that economic growth does unavoidable harm to the natural habitat. Instead we found that while increases in GDP may be associated with worsening environmental conditions in very poor countries, air and water quality appear to benefit from economic growth once some critical level of income has been reached. The turning points in these inverted U-shaped relationships vary for different pollutants, but in almost every case they occur at an income of less than $8000 (1985 dollars). For a country with an income of $10,000, the hypothesis that further growth will be associated with deterioration of environmental conditions can be rejected at the 5 percent level of significance for many of our pollution measures. (Grossman and Krueger 1995 pp 370-371)

In contrast to this statement of confidence in their own research I think it is appropriate to present the result from Stern's article. Measured in 1990 US$ value, the theoretical turning point for sulfur was according to Panayotou 3,137$, Shafik 4,379$, Torras 4,641$, Grossman 5-6,000$, Cole 8,232$, Selden 10,500$, Kaufmann 14,730, List 22,675$ and Stern 101,166$. The lower values, except Panayotou, are from cities and from Cole and onwards for countries. (Stern Internet). The only conclusion it is that this is hard to measure in a 'robust' way.

But this coupling between high GDP and less environmental burden, became the accepted theory in most influential economic circles and reported to the political decision makers at least in rich countries. (Andrén 2004, Dasgupta & Mäler 1994, Hermele 1995, Mäler 1993, Porter 2000, SOU 1993:16, SOU 2000:7). And it was a welcome one. In the mid 1970s, the believers in the free market and perpetual economic growth could only accuse the environmentalist for being wrong, as they did not included the unlimited human creativity to solve problems in their equation (Dryzek 1997, Friman 2002). With the Kuznets curve the business-as-usual group had the empiric 'evidence' that they also were the ones who were right – economic growth was the real guardian angel for the environment.

The reasons it was accepted are twofold. First it was 'comfortable' for politicians in the OECD area to get arguments that their primary choice of policy – economic growth, and that a high level of GDP was beneficial to the natural environment. They could continue with Politics-as-usual that was so liked by the constituencies, at least in wealthier parts of the world. Secondly it fit very well into neoclassical political economic theory – diminishing marginal utility and increasing marginal costs, the environment will with richness become a more 'preferred' commodity (Andrén 2004, World Bank 1992).

One of the strongest proponents in Sweden of the overall benefits of economic growth is Professor Radetzki. He will be my representative for the 'Business-as-usual' group and how they present their arguments. Over the last 20 years or so he has published a number of articles and books telling us not to worry about changes in the natural environment. He means that if streets are noisy and even full of unpleasant particles we can built shopping malls with soft music and filtered air. If the seas where we want to swim are polluted we go to man-made swimming pools instead. (Radetzki 1991)[2] When it comes to the Kuznets curve

---

[2] Translated to English "The technical progress gives increased opportunities to create micro-environments which are better fits to human needs than the natural surrounding, or isolates us from a worsening macro-environment. A somewhat banal example is swimming pools that protect the

his position is quite clear. In his book *Den gröna myten* (*eng.* The Green Myth) he makes a table where he presents the inherent $ value per kilogram for different commodities starting with crude oil and steel with a value of 0.15 and 0.2 US dollar per kilo and ending with a military jet fighter, a soft ware program from Microsoft and a telecommunication satellite with price tags per weight of 6,000, 20,000 and 40,000 in that order. But in first place, being the 'best value for money' is banking services which gets an infinitely sign (∞) for the amount of US$/kg. One starts to wonder why the person being the clerk or provider has only about 800 to 1000 US/kg body weight in annual salary. (What is included in a salary is different for different countries, this is a Swedish example.)

These are the empiric 'evidence' that a high tech production is less resource intensive per unit of GDP and so the more developed the less stress on the environment is the story line. In his own words; "The table is illustrating the falling intensities of basic raw material and environment when societies advance, economically as well as technically." (Radetzki 2001 p 57). He means that with a higher value per kg, less environmental resources are required per $ value.

What he doesn´t elaborate is the amount of fossil fuel the military jet fighter is going to use to be useful and the energy used by all computers using the software and the environmental burden when they are worn out[3]. Or how much emissions that were produced to send the satellite up into orbit?

Finally it would have been valuable to know how much resources the banking clerk needs and how much waste that is generated, for him or her to be able to provide the services, as the services do not come by itself. Anyhow his conclusion is that it works the 'Kuznets' way.

The funny thing about the graph (see Fig. 4 p 288) is that Prof. Radetzki states the World Bank 1992 as the source (Swedish: *Källa*) and that it gives us the outfalls for the years 1960(A) and 2000(B) even though the latter time was 8 years after the World Banks publication and as you can see in Fig 2 p 285, were without any data for year 2000. Furthermore the World Bank graph (see above) uses *absolute* values of *urban* concentrations as the y-axis, whereas Radetzki utilizes the *relative* measure of environmental stress per $ GDP and ends up with a cross *country* data (Swedish: Tvärsnittsdata för länder) [all my italics]. Another peculiar thing that could be read from the chart is that we do not have to worry at all as time seems to heal all problems. As seen in the graph, for all income levels the ecosphere stress will be reduced over time (B is always less than A). But all this argumentation about the salvation of economic growth to the environment, over 70, pages ends abruptly by an explanation that it is only a hypothesis due to technical progress – that in theory it is in principle a possibility. But his own conclusion is;
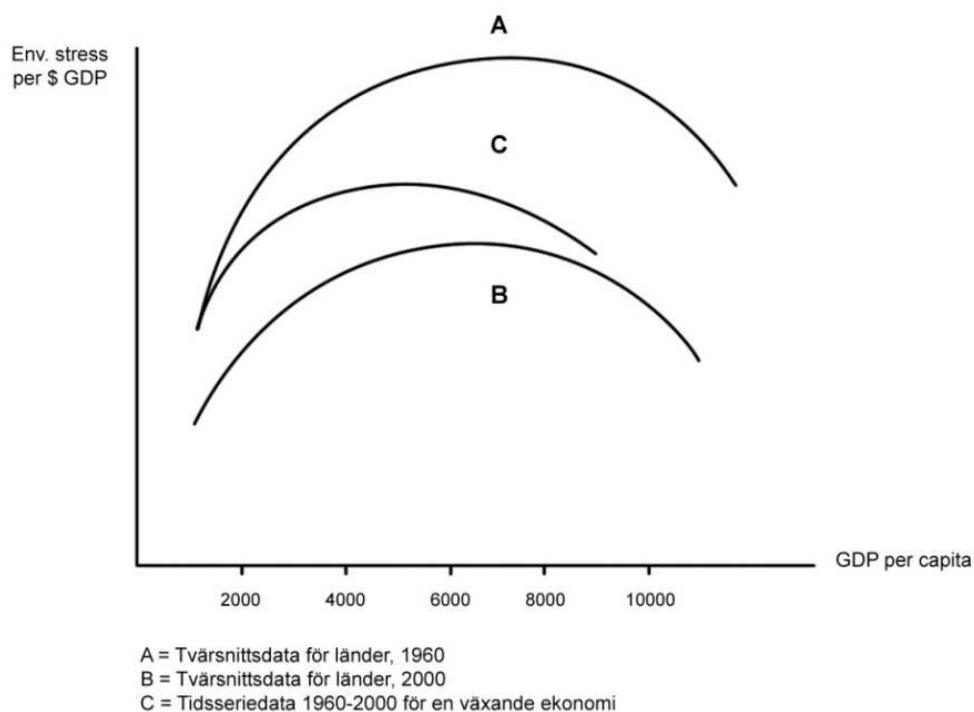
I underline ' in principle' as in reality the economical growth, even in the richest countries, anyhow so far has requested increasing inputs of, and put pressure on, natural resources and the environment. (Radetzki 2001 p 80)

---

swimmers from jellyfishes, unpleasant variations in temperature and befuddlement of see water. Another is encapsulated shopping malls who give the purchasers the opportunity to avoid rain, noise and exhaust gases from the streets (p 53)

[3] Yet today's highly touted "information technology" hardware is based on the water- and energy-intensive and highly polluting manufacture of silicon chips. Clark (2002:28)

290

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

So even though GDP has increased in all OECD countries since 1991, Prof. Radetzki admits that 10 years later (2001) that economic growth is a burden to the natural environment. And he is not the only one when looking at the real world that finds that EKC has very limited support.

It is quite obvious that the debate about the robustness of the EKC-theory is concentrated to the last third part of the graph (where more economic growth is beneficial to the environment). Both environmentalists and Prometheans[4] seem to agree that low conventional GDP is less harmful to the environment. I have not found any statement in the opposite direction presented by these two groups. For the survivalist discourse it is obvious that "an ecosystem can support more human at subsistence level than it can with any greater quality of human life." (Dryzek 1997). The point made by 'Friends of the GDP'-movement was that economic growth after a certain level of GDP will not increase the load on the environment. They have the price mechanism solving the problem (Barnett and Morse 1963, Beckerman 1974, Simon and Kahn 1984, Dryzek 1997.)

A = Tvärsnittsdata för länder, 1960
B = Tvärsnittsdata för länder, 2000
C = Tidsseriedata 1960-2000 för en växande ekonomi

Källa: World Bank, 1992.

Fig. 4. The Radetzki graph. Source Radetzki 2001 p 55

A lot of authors have criticized the hypothesis (Andrén 2004, Perman and Stern 2007, Vogel 1999). One of the more odd ones is the above cited Mäler. When alone he is a supporter (Mäler 1993, Mäler 1994) but together with others, being a co-writer (Arrow et al 1995) he becomes definitely more skeptical. The good thing about the Science article by eleven well known scholars is that it summarizes what has been said about the hypothesis by many. The main points are that:

---

[4] Prometheans is a label for people how see Business-as-usual as the best guaranty for continues welfare.

1. The curve applies to a selected set of local pollutants only, not for the accumulation of waste or long term and more dispersed stress which are often increasing functions of income
2. It has not been uncovered for resource stocks, only for emissions of some pollutants
3. The limited findings cannot be applied to environmental quality in general
4. It doesn´t imply that economic growth is sufficient to improve the environment or that growth effects on environment can be ignored or that the ecosphere is capable of supporting indefinite economic growth
5. It does not say anything about temporal or spatial displacement
6. For the limited cases where emissions have declined with rising incomes it has been due to local institutional reforms, and
7. The solution to environmental degradation lies in such institutional reforms that would compel private users of environmental resources to take account of the social costs of their action. The inverted U-relation is evidence that this has happened in some cases. It does not constitute evidence that it will happen in all cases or that it will happen in time to avert the important and irreversible global consequences of growth.

What has been successful is local initiatives of new laws, the change of production and new strategies to make a state less vulnerable to oil supply (Lindmark 1998, OECD 1991, Porter 2000, SOU 2000:7, World Bank 1992). In the OECD area we could see a lot of environmental laws being put into force in the 1960s and 70s. We had the first 'oil crises' in the beginning of the 1970s so we gave incentives to energy-saving initiatives and new energy technology – the nuclear plant (Mäler 1993). The OECD countries' main concern was not the environment, we wanted sustained economic growth. And that was solved by *political* restrictions on the GDP-creating 'bad' production. Active environmental politics is the major cause to environmental improvements, not GDP *per se*. Even the World Bank, who is the theoretical father of the concept, writes.

In some cases environmental quality improves as income rises. /…/ Some problems are observed to get worse as the income rise. But this is because no incentives yet exist to change behavior. /…/ When societies have decided to enforce a change – through regulations, charges, or other means – environmental quality has improved. /…/ Past patterns of environmental degradation are not inevitable. Individual countries can choose policies that lead to much better (or worse) environmental conditions than those in other countries at <u>similar</u> *[my underlining] income level /…/ The adoption of environmental policies and the investments and the technological innovations by such policies imply that the environmental mistakes of the past do not have to be repeated.* (World Bank 1992 pp 39-41)

But without the backing of appropriate policies, even the most environmentally helpful technologies and practices will not necessarily be applied, unless they are more productive than existing methods. /…/ Rising incomes and technological advances make sustainable development possible, but they do not guarantee it./…/ Effective environmental policies and institutions are essential. (World Bank 1992 pp 42-43)

So the presenter of the 'facts', the World Bank, conclude that it is policies, not the GDP that make the difference. The conclusion of the World Bank is supported by background material from the OECD, which it is worthwhile to quote at length as it shows how business-as-usual economists 'twist' information from the report. It is quite obvious also that the OECD means that there is political action behind the improvements.

292

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

Over the last two decades, control strategies and technologies have been developed in OECD countries for reducing the emissions and concentrations of traditional air pollutants (SO_2, NOx, CO, PM, VOC, O_3). They include: Restriction i.e. use of highly polluting fuels and limits on the sulphur, lead and benzene contents of fuels; - Flue gas treatment after combustion stationary sources, especially from power plants as well as certain large industries, emission controls on motor vehicles. Such control strategies and technical progress have been combined to substantially reduce air pollutant emissions in many countries, against a backdrop of growth and structural change in economies and energy demands. /…/ In spite of the above successes, urban pollution continues to be a problem because: VOC and NOx emissions have generally increased compared with the early 1970s; Ambient air quality standards and guidelines by the WHO for NO_2 and O_3 are still exceeded in many OECD countries; - The air quality in some cities and densely populated regions, especially in the south of Europe, is still deteriorating. The main reasons are that pollution control regulations are not strong enough, or not vigorously enough enforced, and that energy and transport policies do not emphasize energy savings and substitutions capable of offsetting the effects of economic growth. Further, large-scale and international air pollution over the past two decades, air quality has become a concern at rural and remote sites in long-range transport of air pollutants; These increased levels of large-scale air pollution have exerted greater stress on forests and other natural ecosystems, soil, inland waters and crops. Lastly, newly emerging problems also add to the challenges of providing for cleaner air: More and more toxic pollutants (e.g. cadmium, benzene, radon, asbestos) are being released into the atmosphere. – Available evidence shows that indoor air may be of considerably lower quality in many instances than outdoor air, and that people may be exposed to much higher levels of traditional and toxic trace air pollutants than was originally believed, since they spend about 90 per cent of their time in buildings or vehicles. (OECD 1991:49)

So by discriminatory reading innovative economists create the Environmental Kuznets Curve with GDP as the x-axis and use the World Bank and OECD reports as their sources. But this view that a more active environmental policy approach would be beneficial is partly confirmed by UNEP. But they go a little bit further; they talk about a social paradigm shift

Means must be found to tackle the root causes of environmental problems, many of which are unaffected by strictly environmental policies. Resource consumption, for example, is a key driver of environmental degradation. Policy measures to attack this issue must reduce population growth, reorient consumption patterns, increase resource use efficiency and make structural changes to the economy. Ideally, such measures must simultaneously maintain the living standards of the wealthy upgrade the living standards of the disadvantaged, and increase sustainability This will require a shift in values away from material consumption. Without such a shift, environmental policies can effect only marginal improvements. (UNEP 1999:xxix)

Resource consumption is another word for GDP as the production must be bought to be a part of GDP. Other (sarcastic) ways to solve the problem are changed technology (other raw materials and/or procedures without known future consequences today), displacement (reallocate the production plant to less rigorous countries) and the temporal solution, hoping that it will take time before the law makers interfere (It has taken politicians more than 100 years to start to react to warnings about increased CO_2 levels[5]). Or as Arrows puts it;

Where the environmental costs of economic activity are born by the poor, by future generations or by other countries, the incentives to correct the problem are likely to be weak. (Arrow et al 1995 p 520)

---

[5] NASA (Internet)

But one of the most cynical is the one from Nobel laureate Beckerman who in a very arrogant way put forward a recommendation for the ones who are suffering from environmental stress and less development;

… if you want a better environment in general and, in particular, reasonable access to clean drinking water, adequate sanitation and an acceptable urban air quality, you have to become rich. (Beckerman 1995 p 25-6)

Just to sum up the Kuznets controversy I would like to put forward one peculiar statement used in an official survey to give the reader an insight to the different quality of arguments used in the debate. This is what the Swedish Parliament's official survey has to say:

Different studies indicate that a higher income or GDP level can create the conditions for a better environmental quality. However, factors other than income or GDP level as such are important in explaining the turning point. In the Scandinavian countries, for example, the point in time seems to coincide with the turning point rather than the GDP level. (SOU 2000:7 p 128)

2.2 The environmental Brundtland curve

After coming across the concept of EKC and after reading the WCED-report it was a little bit surprising, when making some sort of summary of the arguments there. For the relationship between GDP and environmental stress when drawing a curve using the same analytic frame as for EKC, the graph became close to an upright U. This is just the opposite of the World Bank's Kuznets curve. In the Brundtland report there is very little empiric material and no curve drawn. One has to draw conclusions from the text. But the story line in the WCED-report is quite clear. The poor destroy their environment and the rich theirs (Dryzek 1997)

The most straight forward citation is that "poverty is a major cause for environmental problems" (WCED 1987 p 364). Their activities (deforestation, overuse of marginal land leading to desertification and urbanization) are so intense and so far reaching that it is 'a major global plague' (WCED 1987 p 28) according to Brundtland. The view seems to be that as they are poor they have to prioritize activities that satisfy their most basic needs at the price of environmental quality. And they are many so the total impact is immense. Brundtland stresses 'that the links between poverty, inequality and environmental degradation formed a major theme in the analysis and recommendations' (WCED 1987:xii)

When it comes to the high income part of the World the report is not so categorical but that could be for tactical reasons. In a politically correct way the report is mostly vague and uses words like *sometimes* and *may* when it describe the link between growth – environment and they use the phrase "those not in poverty" instead of "rich" (WCED 1987 p 8 & 55). A typical sentence is

Thus today's environmental challenges arise both from the lack of development and from the <u>unintended</u> consequences of <u>some</u> forms of economic growth. (WCED 1987 p 29, my under linings)

But it is quite clear that the commission also sees a link between production and environmental impacts. But then again they do not say who owns the facilities. But for the purpose of this study it is a question of the link between GDP and environmental degradation and by definition it is the production that creates the GDP. The two 'empiric' paragraphs that show that WCED also see production as an agent for green problems will be:

294

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

Industrial production has grown more than fiftyfold over the past century, four-fifths of this growth since 1950. Such figures reflect and presage profound impacts upon the biosphere /.../ Much of the economic growth pulls raw material from forests, soils, seas, and waterways. /.../ We have in the past been concerned about the impacts of economic growth upon the environment. We are now forced to concern ourselves with the impacts of ecological stress – degradation of soils, water regimes, atmosphere, and forests – upon our economic prospects. (WCED pp 4-5)

In some parts of the world, particularly since the mid-1950s, growth and development have vastly improved living standards and the quality of life. Many of the products and technologies that have gone into this improvement are raw material- and energy-intensive and entail a substantial amount of pollution. The consequent impact on the environment is greater than ever before in human history. /.../ Into every year we now squeeze the decades of industrial growth – and environmental disruption Greater attention to resource efficiency can moderate the increase, but, on balance, environmental problems linked to resource use will intensify in global terms. (WCED pp 31-32)

And from the report one can quite easily indentify the major investors (owners of the production). As an example the report says:

- *In 1983 chemicals accounted for roughly one-fourth of the stock of foreign direct investment in manufacturing in developing countries by companies from four leading countries – Japan (23 per cent) the United States (23 per cent) the United Kingdom (27 per cent) and the Federal Republic of Germany (14 per cent)*
- *Agriculture, mining and other extractive industries accounted for 38 per cent of the stock of US investment in developing countries in 1983, 29 per cent of the stock of Japanese investment in 1983, 21 per cent of the total FRG investment in 1981 – 83 and 9 per cent of the stock of UK Investment in 1978*
- *Eighty to ninety per cent of the trade in tea coffee cocoa cotton forest products, tobacco, jute, copper, iron ore, and bauxite is controlled in the case of each commodity by the three to six largest Transnationals. (WCED p 85)*

There is also indirect "proofs" that WCED sees conventional economic growth as a stress on the environment. They see the necessity to change in the content or the quality of economic growth but at the same time see a renewal.

The world must quickly design strategies that will allow nations to move from their present, often destructive, processes of growth and development onto sustainable development paths. Critical objectives for environment and development policies that follow from the concept of sustainable development include

- *reviving growth*
- *changing the quality of growth*
- *conserving and enhancing the resource base,*
- *merging environment and economics in decision making (WCED p 49)*

Sustainable development involves more than growth. It requires a change in the content of growth, to make it less material- and energy-intensive and more equitable in its impact. These changes are required in all countries as part of a package of measures to maintain the stock of ecological capital, /.../ The process of economic development must be more soundly based upon the realities of the stock of capital that sustains it. This is rarely done in either developed or developing countries. (WCED p 52)

Whereas the World Bank and Kuznets advocates are clear that an increase in GDP in low income countries will result in a significant boost in negative environmental impacts the

policy recommendation from Brundtland (WCED 1987) is just where the economic growth must happen if we are going to have a sustainable development. And this is also surprising as Brundtland wants the World Bank to take an active role in the creation of a renewal of economic growth in low income countries

As Environmental Brundtland Curve is my invention, one cannot find any articles about the subject that either support or reject the hypothesis. But there are reports in line with the idea. UN Environmental Programme (UNEP) writes;

The continued poverty of the majority of the planet's inhabitants and the excessive consumption by the minority are the two major causes of environmental degradation. The present course is unsustainable and postponing action is no longer an option. (UNEP 1999)
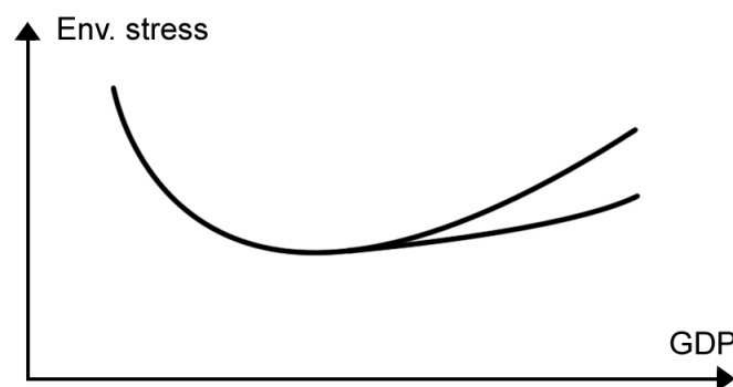
Fig. 5. Environ. Brundtland Curve (EBC)

WCED means that there are signs that the rich have made some improvements from a quite high level of environmental impact. WCED means that technological improvements have made production cleaner and consumption waste less harmful. So there is hope and it is called eco-modernization. The believers in this concept mean that ingenious inventers will solve technical problems as they occur and politicians will change unsuitable institutions when societal development so requires. Environmental taxes are one example. That hope is drawn as the split in the graph. Depending on how creative people with power will be, the curve will turn different ways.

In the Environmental Sustainability Index (ESI) report from Yale University there are also only two parties involved when it comes to environmental stress – the poor and the 'rich'. The rich are causing a negative impact due to pollution pressures of industrialization. What the poor are doing is not specified, just that poverty creates stress (ESI 2005). There is also some support, also without being very precise, in a few other UN documents.

Poverty and environmental degradation are closely interrelated. While poverty results in certain kinds of environmental stress, the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in industrialized countries, which is a matter of grave concern, aggravating poverty and imbalances. (Agenda 21 § 4.3)

The General Assembly, … Concerned about the environmental impact of the irrational and wasteful exploitation and consumption of natural resources, particularly those of developing countries, and

296

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

about the fact that such exploitation and consumption represents a threat to these countries in their exercise of their permanent sovereignty over their natural resources. (Resolution 3326 (XXIX) Report of the Governing Council of the UNEP 16 Dec 1974)

In the last paragraph it is perhaps more a case of developed nations that exploit the developing country that is the cause, rather than the low income country itself.

The only statements one has to judge their standpoints are to be found in WCED's and UNEP's reports where it is in both cases mentioned that poverty causes deforestation and desertification. There is no empirical 'evidence' presented, just a description of the way they see the reality in the country-side of poor countries. In the case of WCED their own arguments have been scrutinized in an earlier article (Bratt 2009) and been found inconsistent.

As I have stated above (in the EKC section) there is no support among Environmentalists or Prometheans for the view that the poor are a major cause of environmental degradation. In WCED's own enumeration they see climate change, ozone depletion, 'toxic' production, hazardous waste, deforestation, desertification, acidification, loss of biodiversity, drinkable water deficiency, ground water depletion, environmentally unsound energy production, the possibility of nuclear war and the mismanagement of the commons as our main ecological problems. Out of all this the low income actors have a part in deforestation and desertification according to WCED. This deforestation is not what other authors conclude. Humphreys is one of them. He is using a UN document as his source when making his table (see Table 1 p 295) (Humphreys 2006).

There are, as seen, a lot of causes so it is hard to say that the poor are causing deforestation. Consider also that illegal logging is not included. Consider also that the developed world has been clearing land for the last 2-3 millenniums for agricultural reasons. Today a few of us replant a monoculture domestically but uses Third World tropical and Monsoon forest to cover our 'needs'. Where is the morality? Consider also that deforestation is a cause of desertification.

But one can also add that the influential background paper produced by Shafik and Bandyopadhyay (1992) used in the World Bank report that became the very foundation for the concept of a Environmental Kuznets Curve, found that among the 10 indicators tested two were about deforestation and "Both deforestation regressions showed no relation between income and deforestation" (Stern Internet).

One can also argue that first of all, the poor pay their price for what is degraded, they internalize their part, but do developed countries do that? Secondly a part of the poor's deforestation is due to survival, but why do we take their trees – at least it is not a survival question for us.

When it comes to desertification a thorough research made by Lambin based on 132 carefully selected case studies came to the conclusion that 'A recurrent and robust broad factor combination implies the interplay of climatic factors leading to reduced rainfall, agricultural growth policies, newly introduced land-use technologies, and malfunctional land tenure arrangements' (Lambin et al 2006 p 340) is the main cause. The category 'poor people' is not mentioned in the paper as a driving factor.

But WCED has a point if it means that due to the poor's weak negotiation position they have to accept the dominant global economic order and see their land being exploited in an

environmentally unfriendly way. If that is what they mean, who shall then be accountable for the harmful emissions and devastating production patterns in a GDP/Environment-diagram? And when we displace our production due to more favourable conditions, both monetarily and a more or less non-existing environmental legislation who is then the moral polluter? I hope Brundtland understands that in this analytical framework I do not consider that the ecosphere degradation is caused by the poor. They might be the agent 'employed' by us.

Underlaying causes								
Direct causes	1	2	3	4	5	6	7	8
Replacement								
By commercial plantations	X					X	X	
Planned agricultural expansion	X	X				X	X	
Pasture expansion	X	X				X		
Spontaneous colonization		X	X	X		X	X	X
New infrastructure						X		
Shifting agriculture			X	X				X
Modification:								
Timber harvesting damage	X		X		X		X	
Overgrazing			X		X			
Overcutting for fuel			X		X			
Excessive burning				X	X			
Pests or diseases					X			
Industrial pollution					X		X	

The column headings for underlying causes are:

1. Economic and market distortions
2. Policy distortions, particularly inducements for unsustainable exploitation and land speculation
3. Insecurity of tenure or lack of clear property rights
4. Lack of livelihood opportunities
5. Government failures or deficiencies in intervention or enforcement
6. Infrastructural, industrial or communications developments
7. New technologies
8. Population pressures causing land hunger

Table 1. Diagnostic framework: Relationships between selected direct and underlying causes of deforestation and forest degradation

2.3 The environmental Daly curve

But there is also a third group, the environmentalists, who have contested the idea of an environmental Kuznets curve. In their world view there are ultimate ecological limits to economic growth (Bratt 2006). For this group there is a positive correlation between growth and ecological degradation and if a curve is drawn it will probably be more geometric than arithmetic. In his book *Ecological economics* Daly (Daly 2004) presents the optimal scale

298

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

diagram (Fig. 6) that includes the "Marginal disutility curve" (MDU) as the lower curve which in his words shall 'reflect the increasing marginal costs of growth, as more natural capital is transformed into manmade capital' (Daly 2004 p 21). For the sake of conformity this is the curve I have baptized as the Environmental Daly Curve.

Daly says himself that he was inspired by Stanley Jevons marginal thinking about work and wages and transferred it to cost and benefits with economic growth versus the environment by using the neoclassical idea of diminishing benefits and increasing costs of consumption and production respectively (Daly 2004). Personally I prefer to date the creation of the thought of confines to monetary progress to The Club of Rome's publication of their contribution to a discussion, *The limits to growth* by Meadows et al. 1972 By this book the social paradigm of Neomalthusianism's were introduced to a wider audience. Here the modern (computer-based) theoretical foundation of a new thinking about the relationship between economic growth and Nature's capability to support it was shaped – that there are ecological restrictions to economical development. I write theoretical as it was a computer created model of explanation to what *could* happen if humanity continued its pecuniary valuating development track at an even higher speed. As it was a prediction about the future there were no empirical facts (it was based on historical facts). This volume was followed by a series of 'green' change-direction books, like *A blueprint for survival* (1972), *Global 2000 Report to the President* (1980) just to mention a few. But it was Daly who drew the line or graph – the marginal disutility curve.
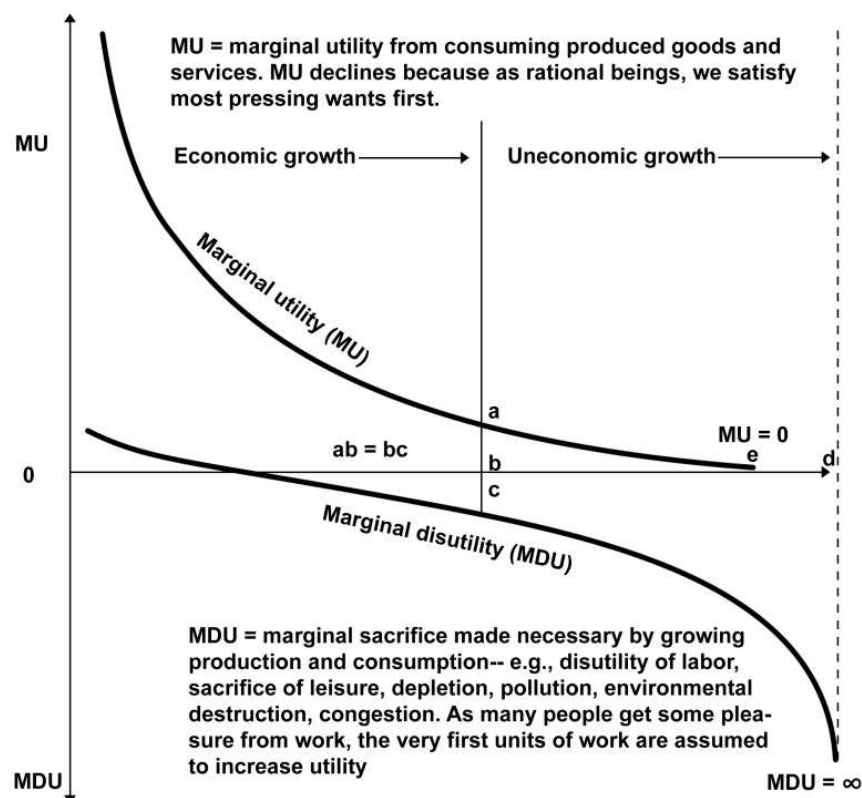

Fig. 6. The optimal scale diagram. Source: Daly 2004 p 20

A fundamental rule in neoclassical microeconomics is that an optimal level is reached when marginal costs are equal to marginal benefits. This is the most optimal scale of micro-

economic activity (Mankiw 2008). That is *ab* = *bc* in fig 6. In macroeconomics such rules do not apply as there is no opportunity costs of growth as macroeconomics deal with what the neoclassical economists consider to be the whole – the economic system. But keep in mind it is the Marginal *disutility* curve that is comparable to the other Environmental curves so we should not be looking at the optimum point but what will happen if we go too far out to the right. The costs of increased economic activity became higher than the benefits. At the end of the day point *d* in the figure 'where an ecological catastrophe is provoked, driving MDU to infinity' (Daly 2004 p 21). And remember, in Daly's case he has drawn the value of disutility downwards. If we cleanse his graph and use the same frame-work as Kuznets' it will look like figure 7. Supporters of this correlation between GDP and environmental stress are actors with the world-view of eco-system limits, that Nature has laws that humans have to obey. Devotees are to be found in the "green" movement and among criticizers of neo-classical economic theory.

Fig. 7. Environ. Daly Curve (EDC)

Daly means as long as the economical system is a part of the whole Earthly system that the model is valid. For ecological economists the economic system is a subsystem to the ecosphere. They have another world view (Bratt 2006). But then again as long as this subsystem was minor in relation to the ecological system, as in old days, still we didn't have to worry about marginal costs. As Daly puts it "In this 'empty-world vision', the environment is not scarce and the opportunity costs to expansion of the economy is insignificant" (Daly 2004 p 17) There was always another place to go to – to seek subsistence like the Europeans did in the mid 19th century when they left starvation for the 'promised' land in the West which was Arcadian except for a 'few' indigenous Indians. Today the World is 'full'. We don't have other places to go to. There is no empty space; there are no 'rooms to let' (see fig. 8). When resources are diminishing we have to take the consequences. Today there are opportunity costs when exceeding the sustainable level of consumption. In addition to welfare (which to a greater extent goes to the 'North'), the economical system creates ecological and social burdens on society, who in turn, due to the high material welfare, creates an overburden of waste with subsequent environmental problems in the 'full world'.

But Daly is not alone looking at the world in this way. There is support to be found in 'official' reports for an environmental Daly curve.

300

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

But the same processes that have produced these gains have given rise to trends that the planet and its people cannot long bear. /.../There are environmental trends that threaten to radically alter the planet, that threaten the lives of many species upon it, including the human species. (WCED 1987 p 2)

Certain environmental problems seem to have a clear-cut, positive relationship with GDP per capita. This is due to the continuing high cost of reducing pollution and the fact that the impact of the pollution is not yet especially obvious (SOU 2000;7)

Resource consumption, for example, is a key driver of environmental degradation. /…/ A tenfold reduction in resource consumption in the industrialized countries is a necessary long-term target if adequate resources are to be released for the needs of developing countries. /…/ The modern industrial economies of North America, Europe and parts of East Asia consume immense quantities of energy and raw materials, and produce high volumes of wastes and polluting emissions. The magnitude of this economic activity is causing environmental damage on a global scale (notably climate change) and widespread pollution and disruption of ecosystems, often in countries far removed from the site of consumption. (UNEP 1999)
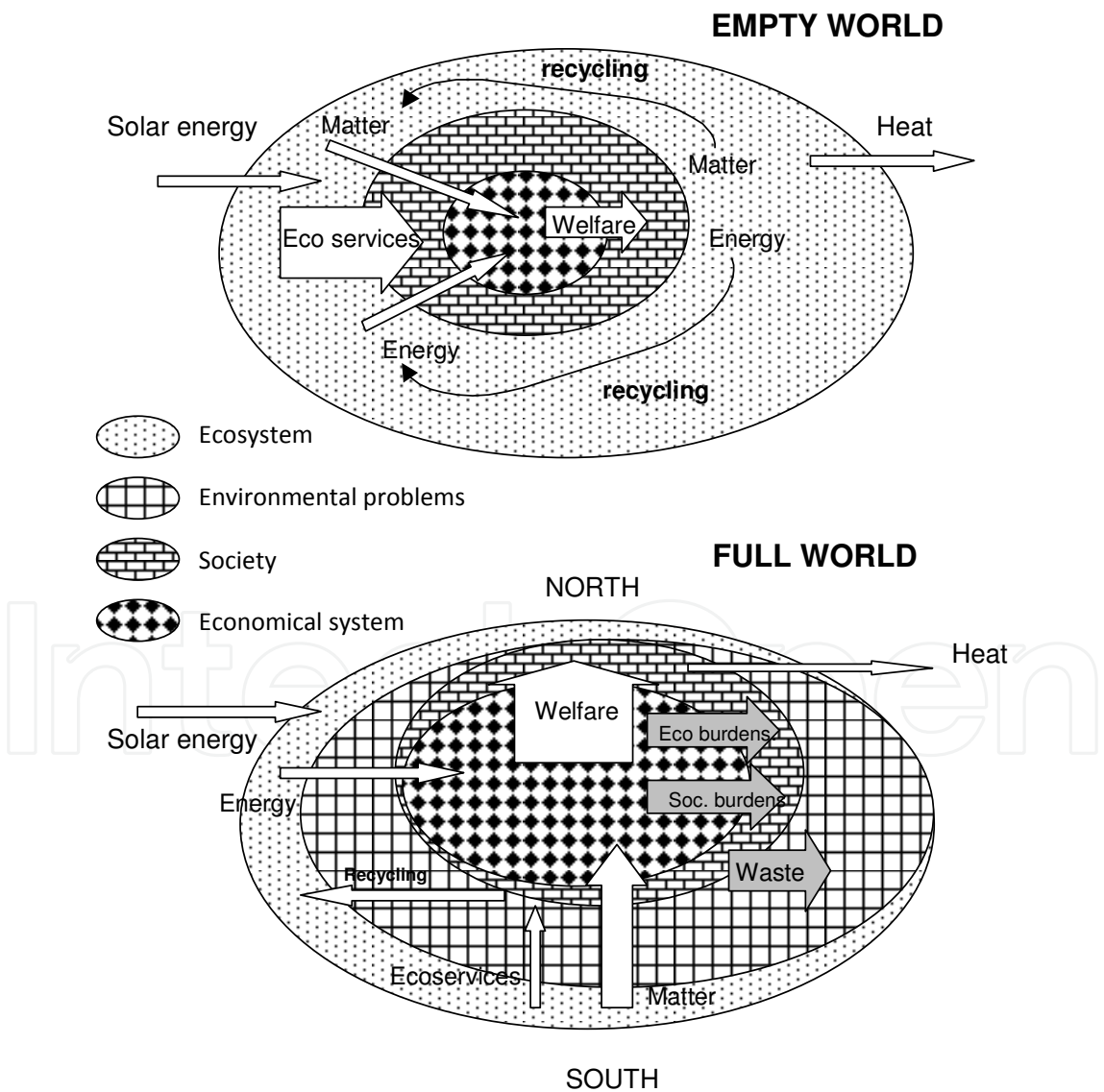
Fig. 8. Daly's worlds. Source: Bratt (2006)

According to UNDP's 1998 Human Development Report, the 20 percent of the world's people in the highest-income countries account for 86 percent of total private consumption expenditures – the poorest 20 percent for a minuscule 1.3 percent. (Porter 2000)

3. Empiric

As the major environmental problems as defined by WCED are global to their character my empiric findings will include the whole planet. Let's first look at the development of the Gross World Product. There is a more or less steady increase during the last three decades, a period when for most people environmental problems became a reality.
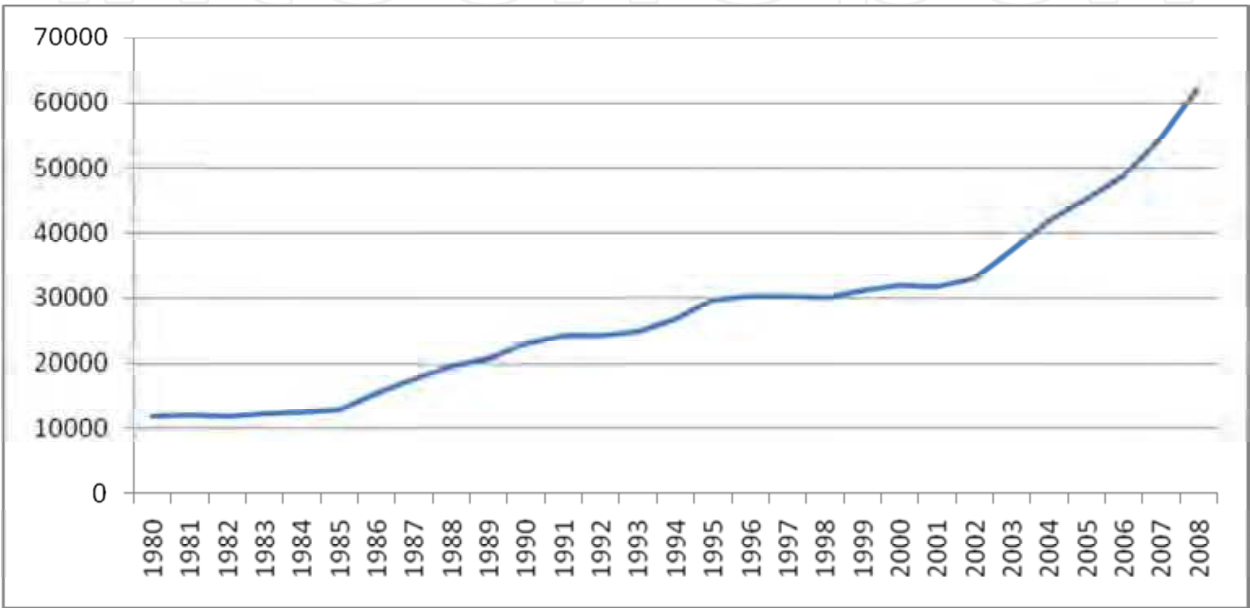
Fig. 9. The Gross Global Production (GGP) in billion US$ and current prices 2008. Source: IMF 2008

As this is total figures and with around 6 billion inhabitants and that Grossman's 10,000US$ were at 1985 prices, we have not reached his estimate for the turning point towards improvements of environmental conditions at a global level, but certainly for a lot of individual countries in the so called developed part of the World, it has happened. But still no nation can be used as a model for how to be in balance with the ecosphere. One of the key ideas in the WCED-report is change and that we have to change now (WCED 1987), that the coming decades will be crucial if we are going to succeed in our crusade against environmental degradation that will be a threat to the Creation's very survival on this Earth.

Over the course of this century, the relationship between the human world and the planet that sustains it has undergone a profound change. /…/ When the century began, neither human numbers nor technology had the power radically to alter planetary systems. As the century closes, not only do vastly increased human numbers and their activities have that power, but major, unintended changes are occurring in the atmosphere, in soils, in waters, among plants and animals and in the relationships among all of these. /…/ The next few decades are crucial. The time has come to break out of old patterns. Attempts to maintain social and ecological stability through old approaches to development and environmental protection will increase instability. /…/ We are unanimous in our conviction that the security, well-being, and very survival of the planet depend on such changes, now. (WCED 1987 p 22)

302

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

Below I will present some of the more well known environmental threats that we face. To start with CO_2 that is a major contributor to climate change fig. 10 shows that a "normal" level seems to be around 180 to 280 ppm. The right side is about 2000 years ago and the left side roughly 400.000 years ago. The top peaks are warm periods and the lower occur during ice-times. During the period that we use to call the industrial era we have managed to increase the level by using fossil fuel to nearly 400 ppm (see below, fig 15 p 303) with most likely dramatic changes in the climate. But for the sake of this paper let's compare the emitter or country with their GDP respectively to see how income contributes to the pollution or causes environmental stress. Fig. 11 shows the increase of emissions along with increased GDP. Long-term sustainable levels (by 2100) are 0,2 – 0,7 ton CO_2/capita and year for a 400 ppm and 550 ppm target respectively (Azar 2002 p 20). The chart is made up by data from 148 countries and it is only 39 who manage the lower 'limit' and 35 more if you accept the upper of 0,7 ton. I think it is fair to say that high GDP countries have an 'overproduction' of CO_2 emissions and that there is no Kuznets-correlation.
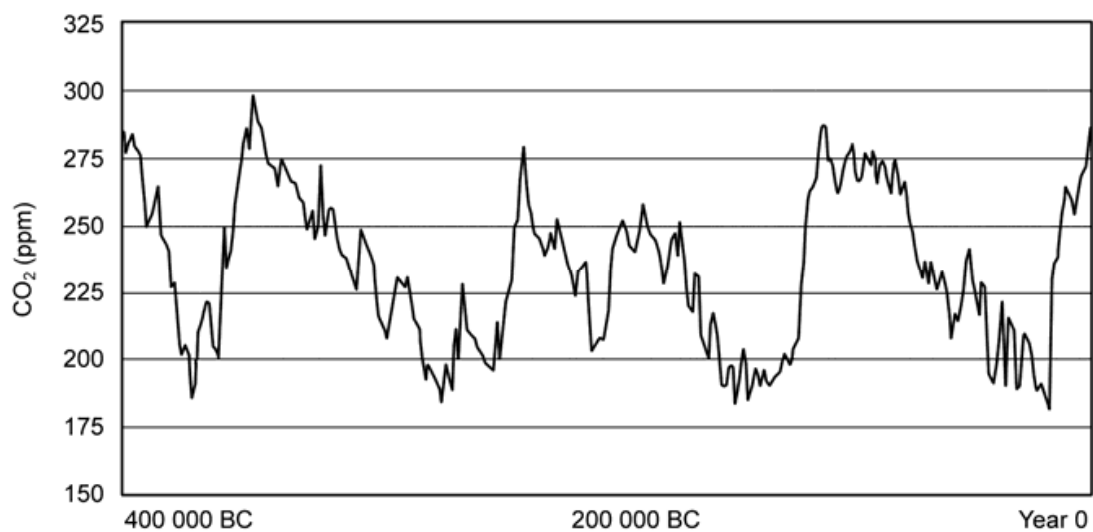
Fig. 10. CO_2 concentration (ppm) during last 400.000 years. Source: Petit et al (1999)
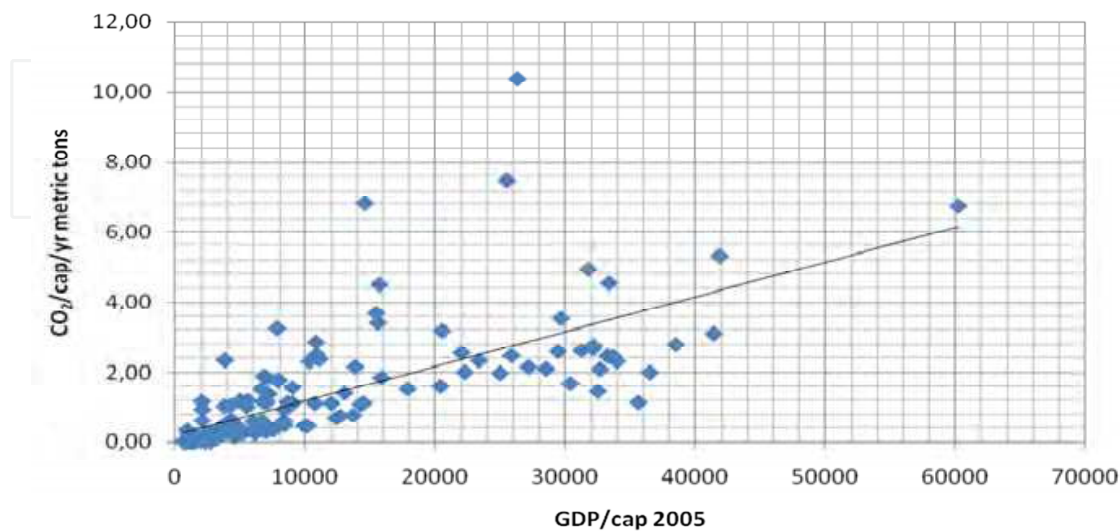
Fig. 11. Correlation between CO_2 emissions/capita and GDP. Source: own chart with data from Explore our planet for CO_2-data and UNEP 2008 for GDP numbers

When it comes to Ozone depletion one can make a curve Kuznets-like if using a spatial parameter (see Fig 12). 'Rich' countries are overrepresented in the tempered zone around the 50th latitude with higher depletion than the low GDP's closer to the equator and where there is very little GDP creation – at the two poles – we have the highest problem and more or less no GDP. So no correlation between ozone depletion and GDP. But the origins of the causative agents were from high consuming countries. But even locking at a temporal x-axis and global values the Dobson Unit-value (an indirect measurement for the amount of ozone) is decreasing despite growing gross global product (GGP). If using the Kuznets analytic frame the curve will actually take the shape of the convex part of the letter D. But then again as NOAA says "All other things being equal, and with adherence to the international agreements, the ozone layer is expected to recover over the next 50 years or so" (NOAA Internet). One can ask if it is due to political agreements or GDPs. Porter says at least that "The ozone-protection regime is considered the most effective of all global environmental regimes to date." (Porter 2000;15)
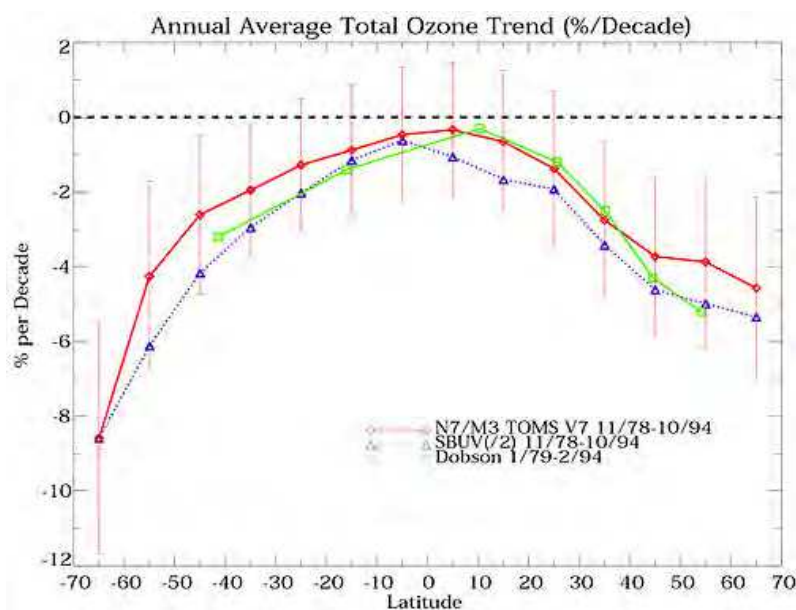
Fig. 12 The Ozone depletion Kuznets curve. Source: CCPO

Another great concern for the WCED was the rate at which species were extinct. WWF has created the Living planet index (see fig 13 p 302) as a measurement for biodiversity. If one wants to be ironic it could also be called the Biodiversity Kuznets curve as it is an inverted U. But in this case it does not mean improvement. The index does not recover with increased GGP, because the temporal scale could also be translated into a GGP. As seen in fig. 9 we have had an increase from 1980 and onwards. A proponent of beneficial economic growth could argue that we haven´t reached the turning point. But then again, before the turning point we should expect a leveling off trend. And that can´t be seen. In the 1970s GGP were 2500 US$, in the 80s 4000 US$ and in the 90s 6000 US$/cap in current prices (2008). So the global biodiversity seems to peak or having its negative turning point around 3-3500 US$/cap. This is in line with the ever increasing demand from us humans on nature to satisfy our needs/wants at the expense of other species. Vitousek estimates that humans now consume something like 40% of Nature's net production and every day the space and resources for other, non-human orders, declines (Wackernagel 1996).

304

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

This global trend suggests that we are degrading natural ecosystems at a rate unprecedented in human history. /.../ The recent downturn in the global economy is a stark reminder of the consequences of living beyond our means. But the possibility of financial recession pales in comparison to the looming ecological credit crunch. (WWF 2008 p 1)
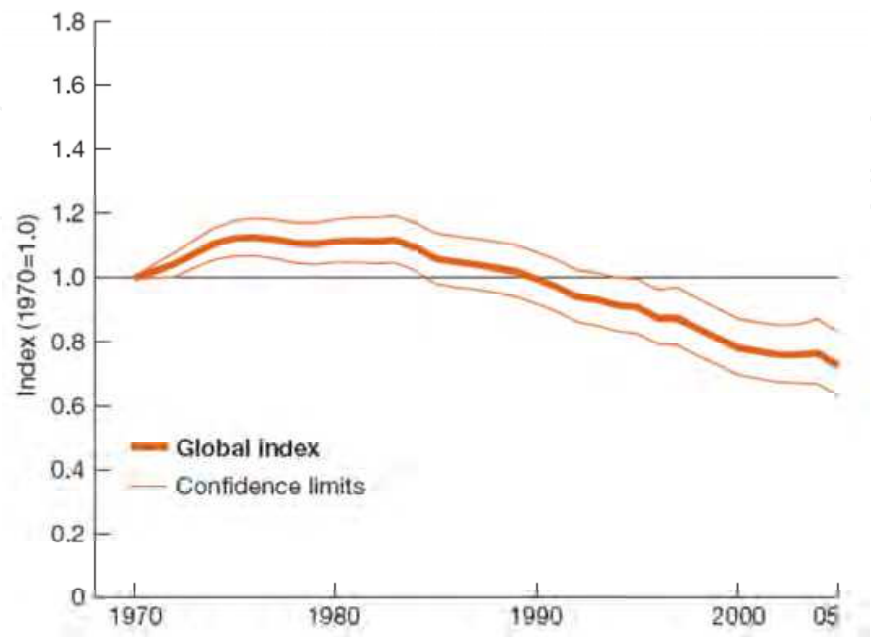

Fig. 13. Global Living Planet Index 1970 – 2005. Source: WWF 2008

In the World Bank report sulphur dioxide (SO_2) was one of the two substances that were empirically tested. The other one was N_2O. When measuring cities there seems to be a drop in SO_2 concentrations but as stated earlier it is due to political will combined with economic reasons. Industries moved out of cities, we built nuclear plants, we taxed sulphur containing oil etc. But looking at larger geographic entities the inverted U-shaped curve is hard to detect (fig 14). Concentration is correlated to emission in a limited atmosphere). An optimist might
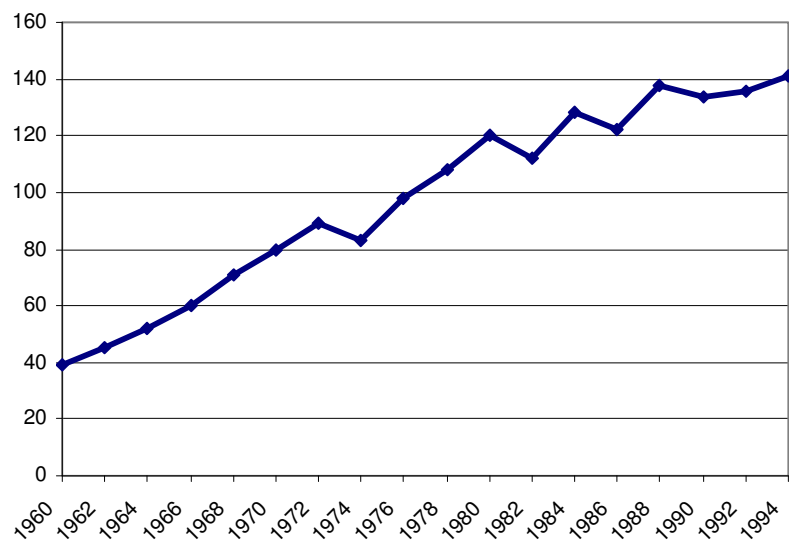
Fig. 14. World SO_2 emission (million metric tons) Source: Downing et al 1997

say that one can see a level off (the beginning of a decline) from the end of the 80s but it could also be explained by the fact that world economic growth also took a break during that period.

The same goes for N_2O, one of the unwanted gases in the atmosphere. Then the proponents of EKC chose to measure *emissions* (not concentration) from *cities* to find the downward slope. It is easy as many producers of N_2O went rural. But again, as this is a gas, it is mixed in the atmosphere quite evenly distributed after what it is produced. N_2O pre-industrial levels were around 260 to 280 ppb. Again one can see a steady increase which is not surprising as the emissions from combustion processes and the use of fertilizers – activities belonging to the industrial era.
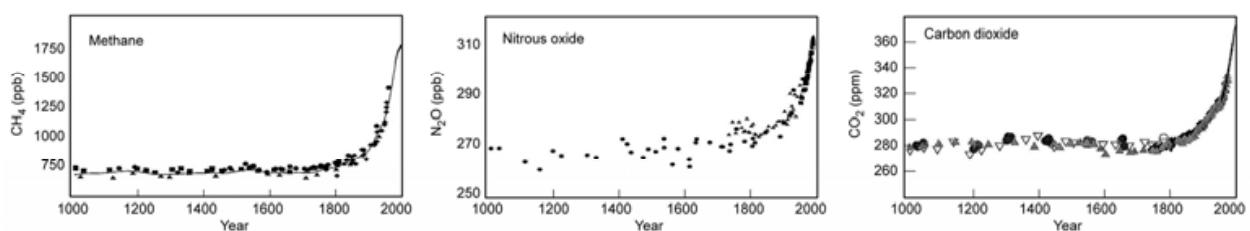
Fig. 15. Global atmospheric concentration of three well-mixed greenhouse gases. Source: Mantua (2007) p 283

When it comes to environmental agreements a great number of states have ratified 14 major global environmental treaties[6] within a timeframe of about 30 years without any correlation to GDP. Poor countries as well as rich countries sign independently of their GDP. As we have around 200 independent nations it is fair to say that a large part of the international community is affected by them. And it is not so that rich countries are first in line to sign. The ones that do not sign seem to have economic reasons not to and this is mostly the rich countries. The Kyoto protocol is perhaps the most notable. (Porter 2000)

As a sum up I will apply the widely well known ecological footprint concept in the EKC analytic framework (fig 16 p 304). As Wackernagel (the founder of the model) says "The Ecological Footprint concept is simple, yet potentially comprehensive: it accounts for the flows of energy and matter to and from any defined economy and converts these into the corresponding land/water area required from nature to support these flows." (Wackernagel 1996:3) That area is a little bit more than 2 ha/cap on a global scale. We have then excluded the needs that all non-human species may have. The conclusion from this chart is that the turning point for an ecological sustainability measured as GDP seems to be around 8000 US$/cap. But in reality less as there are non-human biotic orders on Earth. It is drawn from 143 countries' value of Ecological Footprint.

One explanation of the failure to improve the environment could be what Stern put forward when he says that there is a risk due to the global nature of the externality gives as a result

---

[6] Like Basel, Cartagena, CBD, CITES, CMS, Kyoto, Montreal, Stockholm, UNCCD, UNCLOS, UNFCCC & World Heritage. Source GEO 4 (2007 p. 9)

306

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

that individuals find very little incentives to act (Stern 2007). It is a similar approach that Harding (Harding 1968) presents in his widely cited article *The tragedy of the commons.*
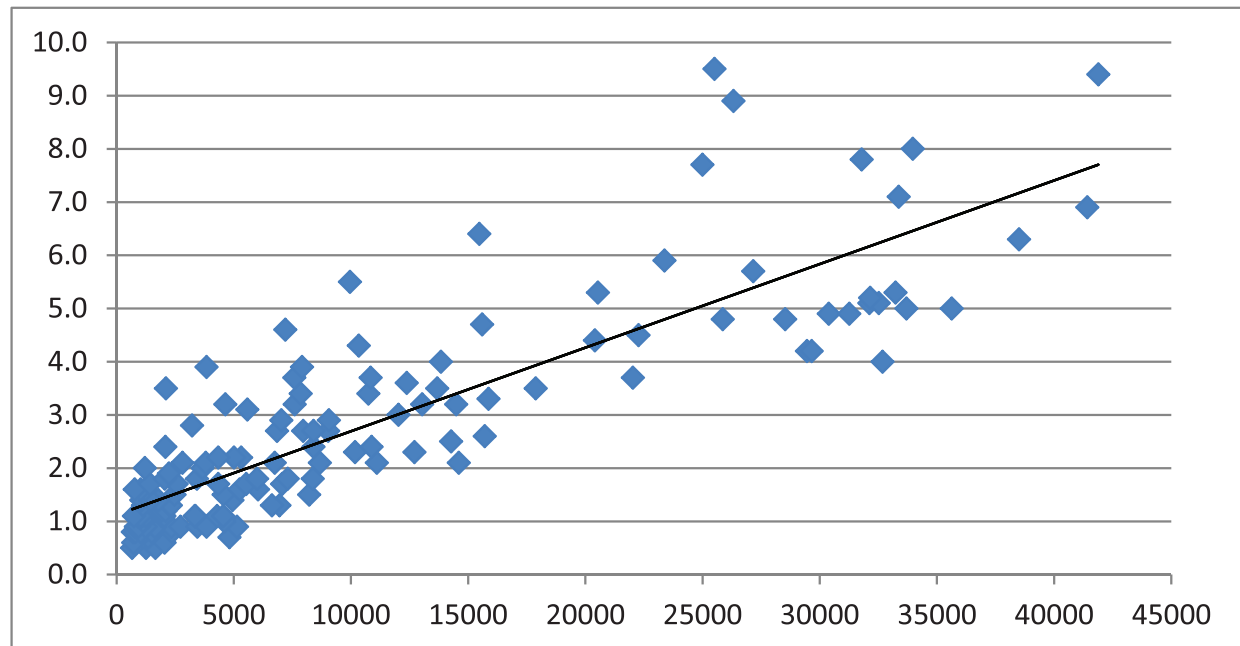

Fig. 16. Ecological Footprint for different countries vs their GDP. Source: own drawing by data from WWF 2008:32-4 and UNDP 2008

4. The problems with the GDP-parameter

Adam Smith's renowned book *Wealth of Nations* (Smith 1776) starts with this paragraph

The annual labour of every nation is the fund which originally supplies it with all the necessaries and conveniences of life which it annually consumes, and which consist always either in the immediate produce of that labour, or in what is purchased with that produce from other nations.

This is the foundation for the idea of GDP, to measure the value of the work the inhabitants of a nation is producing during a year. To know how much they could spend. The x-axis in this survey has mostly been GDP (if not it could be translated to GDP) but that is a very dynamic parameter. It could be measured in 3 different ways,

1. GDP as value added of goods and services (or the value of production at the consumer level)
2. GDP as the sum of profits and salaries
3. GDP as supply balance or expenditures (GNP = (private) consumption + investments/ savings + government spending + (exports – imports)

But it is only transactions that are registered that counts. We do not know the proportions of expenditures or as in the case of China's production and internal consumption as they lend part of the result for someone else to consume (USA). We do not know the Gini-coefficient or division between profit and salary and at what time the money is consumed. We have both a temporal and spatial displacement of GDP and environmental consequences. A paradox is also that ecological disasters create GDP. As an example, the Exxon Valdez tanker disaster,

which spewed 11 million gallons of crude oil over the pristine shores of Alaska in 1989, also led to a short GDP increase due to the costs of the massive clean-up operation.

We use PPP (a cost-of-living adjustment between different countries) or McDonald index to make GDP figures more comparable. Inflation is also excluded to make figures from different years analogous. But shouldn't we also implement a quality factor? Before the time of mass consumption I think we can agree that dairies were more 'natural'. Industrial efficiency had not at that time influenced the quality with artificial additives to speed up production or allow for longer transportation and/or shelf-life in the store. Is a small farm chicken from 1920 in quality comparable to an industrial chemically stuffed chicken from the 21th century? GDP is supposed to measure the production, how much we can consume. The work we have to put in to get a chicken is much less today – so we are richer. But GDP will not be adjusted for the quality change. A friend of order might say that we are paying more for the 'bio-chicken'. Yes that is true, but should we then compare the 1920s chicken with the bio-chicken to see how much richer we really have become?

The reason for doing the GDP/Environmental stress relation curve is that GDP is considered a measure of standard of living. But is it? The Human Development Index, which also includes life span expectation, literacy and provisions of schools and the Genuine Progress Index aggregate something like 15 different parameters to measure human well-being, suggest otherwise. Other scholars like Maslow, Max-Neff and Dodds (Dodds 1997) argue that the quality of life is much more intricate to measure than to reduce it to the pecuniary value of the industrial production.

In the case of environmental curves it could be argued that what has been measured to create the inverted U-shape curve is *urban* concentrations/emission of pollutants. These have been compared to a parameter that measures the performance for a whole country. So by moving out production sites from cities to rural areas one can decrease urban pollution and at the same time keep the high GDP. This movement was quite profound in the 1960s and 70s due to very high prices for real estates in central city areas of high income countries.

The numbers in GDP are *sales-figures*. When the producer sells a liter of gasoline for say 1,5 € that will be added to the GDP. But at the same time when we consume the gas we lose the resource (the capital valued 1,5) and that is not counted for. When it is used it will also add to the CO_2-concentration in the atmosphere (environmental costs) and that is not either reduced from the GDP. When looking at corporations' key performance indicators, the normal thing is to read the balance-sheet to find the value of different assets and debts. The most common markers are liquidity and solidity. Only sales figures are not the primary source of information when we want to know the status of a company's economic situation. At least we need a consolidated statement of income with both sales *and* costs. We want to see if we have made a profit. It is the balance-sheet that gives us the information about the amount of resources (capital) we have and over time tells us if these are growing or decreasing. On the debt side we have the value of how much we owe the suppliers. To make a comparison with the global world, an environmentalist could argue that this is the same as the value humans have taking out of the environment without "paying" back. And if we don't pay our suppliers the will stop to deliver. In this world it is the Nature that delivers the needed resources to society. Companies without suppliers are impossible to run and it is

308

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

quite obvious that society without the Nature as provider of de natural resources we cannot continue to run Mother Earth.

Could it be that institutional stability both enhance growth and environmental benefits and that the GDP itself is not the mainspring to environmental improvements? So when there is growth we can sometimes see local improvements not because of the growth *per se,* but due to responsible politicians who both creates stability (for growth) and take sustainability a little bit more seriously than in countries with less developed institutions? As said in Brunetti's work *Politics and economic growth* at least "that a political system that include transparent, orderly, incremental law-making process" and a broad citizens participation via a strong party system, is needed to be growth enhancing. (Brunetti 1997) The World Bank itself in the report from 1992 states that it is politics, not the GDP-level, that determines the environmental outcome.

5. Discussion

Can we afford every country to develop economically and pass the "turning point"? What will happen to the environment on the journey up to the top of the curve? It seems that the environmental negative trespassing point – when we consume more than we have – lays around 8.000 US\$ (see fig. 17, footprint/GDP-diagram) with current global population. If everybody is going to have that income and keep present consumption patterns we need 4 to 5 planets Earth ???? If the Earth we have has a limited capacity and sustainable development is about satisfying everyone's needs and if we want to lift the low GDP countries towards a decent standard of living it has to be at the expense of the 'Rich'.

Another way to do it, is to slowly and in an orderly way take low income countries, one by one in a pace that the ecosphere can stand, over the 'hill' to the 'blessed' high income, low environmental impact countries. But that could only be good policy if you believe in the Kuznets curve. The empiric evidence has shown that this is not the case, at least not for global problems. It seems that they get worse with increased GDP. So we have a paradox. What could be the guideline if locally perceived problems are solved with increased GDP but global real, but unperceived, stresses get worse by the same economic growth?

And another matter of concern is the question, what will happen to the credibility of the academic world if we with our scientific methods (that are legitimizing us) can deliver answers or theories to totally different world views, that logically cannot co-exist?

An additional unease is the issue of finding a mutual or joint solution to begin the journey on the path towards sustainable development if different paradigms like business as usual that believe in the free market, the eco-modernist who believes in indefinite human creativity to solve problems and the doomsday prophets who are totally convinced about the ecosphere's absolute limits, can get answers from the scientific society that make them feel confident that they are themselves right respectively and the others are wrong.

Due to lack of space it is not possible to expand this perspective of different actorgroups (including scientists) trying to influence the interpretation of research results. I have read Coase's. *The Problem of Social Cost* (Coase 1960), which was the background paper for what was later created as the so called Coaese theorem, which states that there are possibilities to find a free-market solution to environmental stress (Coase himself has the opposite opinion).

Meadows' *Limits to Growth* (Meadows et al 1972) where the conclusion is that we *might* run out of vital resources if humanity continues to exploit the nature at current exponential pace and finally the reports about Ozone depletion (Molina, M. 1974, Rowland, F 1994) and part of the argumentations that followed their publications.

If we scrutinize the debate within the scientific community regarding these three examples, I am convinced we will find that that the academic world is invested with values and that an ideology orientation is a partial compass when we do research. Scholars are guided by what Söderbaum (2008) calls a mental map and Schumpeter (1954) a preanalytic cognitive act. Daly puts it this way; "One might say that vision is the pattern or shape of the reality in question that the right hemisphere of the brain abstracts from experience. Whatever is omitted from the preanalytic vision cannot be recaptured by subsequent analysis"(Daly 2004 p 23). In my opinion we should start to more openly discuss if it is time to include the writer's values in the scientific method to make it credible.

6. Conclusion

When it comes to opinions about environmental curves it is easiest to find pro and contra arguments for the EKC as this is the one where establishment and environmentalists clash. When we look the other way around, towards the EDC it seems that industrialists and producers use the tactic of silence. One has to go back to the beginning of the 1970s after the publication of *Limits to Growth* to find any substantial attack on the environmentalists idea of limits to growth. The Brundtland world-view on environmental curves is not as controversial as 'she' has a solution for the high income countries – eco modernization. Although the moral dilemma with transnational displacement of 'dirty' production to developing countries and keeping the high GDP generating high-tech 'clean' production in the West is a question of fair distribution. But then who is going to produce the commodities we in the west want for a low price is a question that is not answered.

The EKC seems to be a time limited success in a local jurisdiction. And the reason for its appearance does not seem to be environmental consciousness but economic consequences. The losses for forest owners in Northern Europe due to the so called 'acid rain' triggered the political community to action. After Rachel Carsons book *Silent Spring* and that her qualms were verified in Minamata, and Itai-itai, (chemical poisoning) the Club of Rome's *Limits to Growth* and other environmental publications forced the politicians to act with more legislation to satisfy local opinion. This was amplified by the first so called oil crisis in the beginning of the 1970s.

It is hard to find environmental stock/GDP-curves of 'catches' from Nature (i.e. mines, forests or fisheries) that shows a long run sustainability. Instead 'The Newfoundland Cod fishing environmental Curve' could be a good example. For over five centuries the Grand Banks off the coast of the Canadian island of Newfoundland were the richest fishing grounds in the world. The moral of the Newfoundland cod collapse is simple: over-exploiting natural resources such as fisheries, forests or raw materials is good for short term GDP growth but disastrous for ecosystems, economies and communities in the long term.

When it comes to EBC there has been no debate as it is my own invention. One can albeit say that it gets support from UNEP, but the arguments again is deforestation, desertification. And for these arguments Brundtland is very inconsistent, to say the least,

310

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

and UNEP doesn't show any empirical evidence. It is just an opinion. When it comes to deforestation there are a lot of other factors influencing the outcome. And as deforestation also is a cause for desertification, it follows that neither WCED nor UNEP can state that low income countries are the cause. The arguments for the poor to be a major cause of environmental deterioration are very 'poor'.

The critique against the environmentalist is that they forget to include technical innovations and human creativity. They are normally doomsday prophets. Another argument is that the Business as usual group can show improvements in richer countries – they can afford to clean up. What they forget is displacement or the rucksack.

One must keep in mind that EKC deals with waste, (emission or concentration), EBC deals with production as an agent for environmental degradation at least in poor countries whereas EDC and ecological footprints look at consumption as the parameter to measure. But as Marx already said, production is at the same time consumption – consumption of natural resources.

If one concentrates the global environmental problems to the ones defined by WCED and tries to find empiric evidence, it is quite obvious that there is no decoupling between GDP and environmental problems. Instead it seems that there is a positive monotonic relationship between economic growth and environmental problems.

7. Acknowledgment

8. References

Andrén, S. (2004) *Hållbar tillväxt - möjlighet eller motsägelse?: En granskning av EU:s Lissabonstrategi ur ett humanekologiskt perspektiv.* Master thesis, Lunds Universitet

Arrow, K. (1995) Economic Growth, Carrying Capacity and the Environment. *Science vol 268 1995*

Azar, C., Holmberg, J., Karlsson, S., (2002). Decoupling - past trends and prospects for the future. Paper commissioned by the Swedish Environmental Advisory Council (Miljövårdsberedningen). http://www.sou.gov.se/mvb/pdf/decoupling.pdf

Barnett, H., Morse, C (1963) *Scarcity and Growth: The Economics of Natural Resource Availability.* Baltimore: Iohns Hopkins University Press for Resources for the Future.

Beckerman, W. (1974), *In Defense of Economic Growth.* London: Cape.

Beckerman, W. (1995) *Small is Stupid: Blowing the Whistle on the Greens.* London: Duckworth.

Booth, D. (2004) *Hooked on growth – economic addictions and the environment.* Rowman & Littlefield Publisher Inc, Oxford

Bratt, L. (2006) Ecological economics – worldviews of the initiators and their conclusions. In Frostell B. ed. *Science for Sustainable Development.* Proceedings 1th VHU conference, Västerås

Bratt, L. (2009) The Brundtland link between poverty and environmental degradation, and other questionable opinions. *Int. J. Innovation and Sustainable Development*, Vol. 4, No. 1, pp. 74–92.

Brunetti, A. (1997) *Politics and economic growth.* OECD, Paris

Brännlund, K., Kriström, B. (1998) *Miljöekonomi* Studentlitteratur, Lund

CCPO (Center for Coastal Physical Oceanography, Old Dominion University) http://www.ccpo.odu.edu/~lizsmith/SEES/ozone/class/Chap_9/index.htm [2011-06-15]

Cherni,J. (2002) *Economic growth versus the Environment*. Palgrave, Basingstoke.

Clark, M. (2002) *In search of Human Nature*. Routledge, London.

Coase, R. (1960) The Problem of Social Cost. *Journal of Law and Economics*, 3(1) pp 1-44

Daly, H. (2007) *Ecological Economics and Sustaiable Development.* Edgar Elgar Cheltenham, UK.

Daly, H., Farley, J. (2004) *Ecological Economics. Principles and applications*. Island Press, London

Dasgupta, P. and Mäler, K.-G. (1994): *Poverty, Institutions, and the Environmental-Resource Base*, World Bank Environment Paper no. 8,

Dearing, J.A. (2007) Human-Environment interaction: learning from the past. In Costanza, R, Graumlich, L., and Steffen, W. (ed) *Sustainability or Collapse? An intergrated history and future of people on Earth.*The MIT Press, London, U.K.

Dodds, S. (1997) Towards a 'science of sustainability': Improving the way ecological economics understands human well-being. *Ecological Economics* 23 (1997) 95-111

Downing, R., R. Ramankutty, J. Shah, (1997) *RINS-ASIA: An Assessment Model for Acid Deposition in Asia*. The World Bank, Washington, D.C.

Dryzek, J.S. (1997) *The Politics of the Earth – Environmental Discources*. Oxford University Press, Oxford

ESI (2005*) Environmental Sustainability* Index. http://www.yale.edu/esi/ [2011-09-25]

Explore our planet http://exploreourpla.net/climate-change/co2-emissions-historical [2011-06-15)

Friman, E. (2002) *No Limits, the 20th Century Discourse of Economic Growth* Skrifter från institutionen för historiska studier 2, Umeå universitet.

GEO4 (2007) *Environment for development*. UNEP http://www.unep.org/geo/geo4.asp

Grossman, G. Krueger, A. (1995): Economic Growth and the Environment, *Quarterly Journal of Economics*, vol. 110, pp. 353-377

Harding, G. (1968) The tragedy of the commons. *Science* 162(1968):1243-1248

Humphreys, D. (2006) *Logjam: deforestation and the crisis of global governance*. Earthscan, London

Hermele, K. 1995. *Ekonomerna, tillväxten och miljön*. Stockholm: Carlsson Bokförlag.

IMF (2008) World *Economic Outlook*, April 2008 Ed.

Kahn, H. et al (1976) *The Next 200 Years*. William Morrow, New York.

Lambin, E., et al . (2007) Integrated Human Environment Approaches of Land Degradation in Drylands. In Costanza, R, Graumlich, L. and Steffen, W. (ed.) *Sustainability or Collapse? An intergrated history and future of people on Earth*. The MIT Press, London, U.K. p. 337-352

Lindmark, M. (1998) *Towards Environmental Historical National Accounts for Sweden.*

Mankiw, G. (2008) *Principles of economics 5th ed. South-Western Cengage Learning*. Mason, Ohio, USA

Mantua, N. (2007) Decadal Chronolgy of 20th-Century Changes. In Costanza, R, Graumlich, L. and Steffen, W. (ed.) *Sustainability or Collapse? An intergrated history and future of people on Earth*. The MIT Press, London, U.K. p. 277-299

Meadows, et al (1972*) The limits to growth*. Universe Books, New York

Molina, M., Rowland, F. (1974) Stratospheric sink for chloroflouromethanes: chlorine atom-catalysed destruction of ozone. *Nature* 1974:249, pp 810-812

Mäler, K-G. (1993) Growth and environment. In SOU 1993:16 *Nya villkor för ekonomi och politik*

Mäler, K-G. (1994) *Economic Growth and the Environment*. Beijer Reprint Series No. 37

NASA, http://earthobservatory.nasa.gov/Features/Arrhenius/ [2011-06-15]

312

Sustainable Development – Education, Business and Management –
Architecture and Building Construction – Agriculture and Food Security

NOAA http://www.ozonelayer.noaa.gov/science/basics.htm [2011-09-25]

OECD (1991) *The State of the Environment*

Panayotou, T. (1993) *Emperical Tests and policy analysis of environmental degradation at different stages of economic development.* Working paper 238, Technology and employment program. International Labour Office, Geneva

Pearce, D. (1993) *Sustainable Development and developing countries economies.* In Turner, R. ed. (1993) Sustainable Environmental economics and management. Belhaven Press, London. p. 72-105

Perman, R., Stern, D. (2003) Evidence from panel root and cointegration tests that the environmental Kuznets curve does not exist. *Australian Journal of Agricultural and Resource* Economicsvol 47

Perrings, C. (1989) Environmental bonds and environmental research in innovative activites. *Ecological economics* 1(1989) 95-110

Petit et al. (1999) Climate and atmospheric history of the past 400.000 years from Vostok ice core, Antartica. *Nature* vol. 399 (6735), pp, 429-436

Porter, G. (2000) *Global Environmental Politics.* Westview Press, Oxford

Radetzki, M. (1991) *Tillväxt och Miljö.* SNS förlag, Stockholm

Radetzki, M. (1992): Economic Growth and the Environment, in: P. Low, (ed.*): International Trade and the Environment World Bank Discussion* Paper no. 159, Washington D.C., pp. 121-136

Radetzki, M. (2001): *Den gröna myten – ekonomisk tillväxt och miljöns kvalitet.* SNS Förlag, Stockholm.

Rowland, F., Molina, M. (1994) Ozone depletion: 20 years after the alarm. *Chemical and Engeneering* News 1994:72 pp 8-13

Schumpeter, J. (1954) *History of economic analysis.* Oxford University Press, Oxford.

Simon, J., Kahn, H. (1984) *The Resourceful Earth: A Response to the Global 2000 Report.*New York: Basil Blackwell.

Smith, A. (1776) *An Inquiry into the Nature and Causes of the Wealth of Nations.* 5th ed. 1904. Methuen & Co., Ltd. London

SOU 2000:7 *The long-term survey1999/2000*

SOU 2000:7 *App. 2 Långtidsutredningen Miljö och ekonomi – scenarier fram till 2015*

SOU 2000:*7 App. 7 Långtidsutredningen Vad är hållbar utveckling*

Stern, D. (Internet) *The Environmental Kuznets Curve .* http://www.ecoeco.org/pdf/stern.pdf [2011-06-15]

Stern, N. (2007) *The Economics of Climate Change: The Stern Review.* Cambridge University Press.

Söderbaum, P. (2008) *Understanding Sustainability Economics – towards pluralism in economics.* Earthscan, London.

UNEP (1999) *GEO2000, UNEP's Millennium Report on the Environment*

UNDP (2008) *Human Development Report 2007/2008*

Vogel, M. (1999) *Environmental Kuznets Curves Springer Berlin*

Wackernagel, M., Rees, W.(1996) *Our ecological footprint – reducing human impact on the Earth.* New Society Publishers, Gabriola Island, Canada.

WCED (1987) *Our Common Future.* Oxford University Press, Oxford

World Bank (1992) *World Development Report 1992: Development and the Environment*

WWF (2008) *Living Planet Report 2008.* World Wildlife Foundation
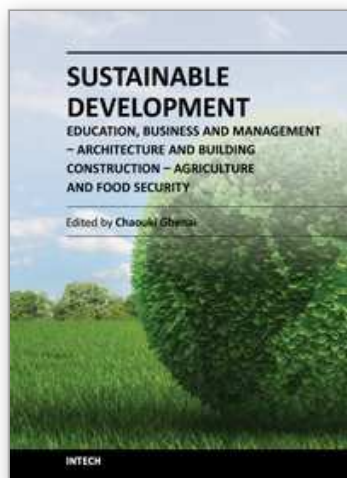
Securing the future of the human race will require an improved understanding of the environment as well as of technological solutions, mindsets and behaviors in line with modes of development that the ecosphere of our planet can support. Some experts see the only solution in a global deflation of the currently unsustainable exploitation of resources. However, sustainable development offers an approach that would be practical to fuse with the managerial strategies and assessment tools for policy and decision makers at the regional planning level. Environmentalists, architects, engineers, policy makers and economists will have to work together in order to ensure that planning and development can meet our society's present needs without compromising the security of future generations. Better planning methods for urban and rural expansion could prevent environmental destruction and imminent crises. Energy, transport, water, environment and food production systems should aim for self-sufficiency and not the rapid depletion of natural resources. Planning for sustainable development must overcome many complex technical and social issues.

INTECH
open science | open minds