

**June 2, 2003 – Plenary Session V**

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**Treading Lightly: Understanding and Reducing the Human Footprint**

I feel very honored to be here with you all this morning on this very special day. My work with the Ecological footprint concept, the theme for this presentation, began in 1996 when Mathis Wackernagel made his first visit as a guest researcher at my department, the Human Ecology division at Lund University. I have learnt a lot over the years from the cooperation with Mathis, I admire his dedication to work for sustainability and he has also been kind to share materials with me for this presentation. These are the reasons why he figures on this slide, together with the name of the non-profit organization Redefining Progress where he is now continuing to develop the footprint approach.

What I and Mathis, and probably many others have in common is that we are concerned about the fact that so many express their interest in sustainability, but so few are prepared to define in more specific terms what it actually means. We suspect that this has got to do with fear of some kind. Possibly, many of us have a personal fear of what sustainability requires. We know that there are some huge social and ecological challenges out there but talking about it make us feel uncomfortable or make us feel blamed. And knowing others as we know ourselves, we fear that others would also feel uncomfortable or would blame us if we really got specific about what may be necessary in order to meet these challenges in a way that is fair and effective. We are even afraid that they would be against sustainability if we said what it is really about. The problem is we're just fooling ourselves by avoiding the issue. Not defining sustainability only increases the current confusion, thereby cementing business as usual, makes conflicts bigger by denying them, defers costs to those on the margin, and makes it more difficult to deal with conflicts constructively.

The ecological footprint tool allows us to explain what sustainability means in a simple and pedagogic way, translating the often abstract sustainability ideas into specific measurable aspects that are easy to understand. It takes its point of departure in the idea that a sustainable world depends on all people having satisfying lives, but within the means of nature. The resulting description of the challenge sustainability is very straight forward, namely to secure people's quality of life within the means of nature. Now what is meant by the means of nature? It is important to understand that humanity, much as all other life on Earth, is ultimately dependent on the limited capacity of ecosystems to produce high grade matter and energy and to recycle waste. Let us take the example of a cow grazing on a meadow. In order to live, the cow is dependent on the natural processes that provide her with grass and take care of her waste. Although dependent on a much wider variety of ecological goods and clean-up services, the human economy is comparable with the cow in that in order to persist, it needs to take in high-grade matter and energy and get rid of its waste. Nature has the means of giving life both to cows and human economies, but there are limits to how much it can provide. Much as the farmer has to make sure that the meadow is large enough for the

number of cows he wants to put there, we as humans should ask ourselves if the biosphere really has the means to support the current expansion of the human economy.

Let us imagine that we could look down on Earth from outer space. We would see the surface of the Earth, and we would understand that it is a limited area: 51 billion hectares approximately. We might also realize that the biologically productive areas of the Earth, i.e. the areas pretty much covered by plant life, are unevenly distributed. A large part of the surface consists of deserts, like Sahara, ice caps, mountain tops, deep oceans etc. FAO has shown that about 25% of the surface of the Earth captures almost all of the biological productivity, counted in dry biomass. The means of nature when translated in spatial terms are thus 11,4 billion hectares of biologically productive land and water.

How much biologically productive space is available per person on Earth? In order to know this we have to divide the bioproductive portion of the Earth's surface, i.e. 11,4 billion hectares, with the number of people that live here now. The current global population is 6,2 billion people. 11,4 billion hectares divided by 6,2 billion persons gives us the average supply per person of 1,9 hectares of bioproductive space.

This global supply, i.e. the biocapacity available on average per person can now be compared with the area of biologically productive space that we use, the global demand. This is what is expressed in the ecological footprint. The footprint is a way of adding up the different spaces that provide us with the resources and service that we need. By use of official statistics on production and trade from FAO and other internationally recognized sources, the footprint tool aggregates the spaces that we use for food, fodder, fibres and energy etc. It includes bioproductive sea space, bioproductive land, where we find the subcategories arable land, forest and pasture. It also includes built space and energy land. Built space is the potentially bioproductive areas that we have paved over and built over. The biggest part of Energy land is attributed to our fossil fuel consumption and this can be represented in two ways. The most commonly used method is to express it as the areas of newly planted forest that would be required in order to prevent the accumulation of carbon dioxide in the atmosphere that results from our use of fossil fuels. This approach is based on the 1992 UN Framework convention on Climate Change. Alternatively, the footprint of fossil fuels can be calculated as the areas that would be necessary in order to produce the same amount of energy biologically, by for example using forests like we did in the past. The two methods produce approximately the same results, which is not surprising since both approaches are based on the same carbon cycle. In addition to these area assessments, many argue that we should also leave some space for other species, so called biodiversity land, but such areas haven't even been included in the calculations presented here, in order to keep the results conservative.

How big is our Ecological Footprint now? What the footprint calculations show us is that we use on average 2,3 hectares of biologically productive space per person. But of course, the size of footprints varies considerably between nations and also within nations. Let us look at some examples. The average Finnish uses 8,7 hectares while the average Polish has a footprint of 3,7 hectares. These examples from the Baltic sea can also be compared with the much smaller footprint of the Chinese, or the even smaller footprints of the average Bolivian and Ethiopian, or with the bigger footprint of an average American.

As some of you may already have realized the average footprint of the global citizen (2,3 hectares) is larger than the available biocapacity (which was 1,0 hectares). We are actually using more of the planet than there is. If we look at it over time, we find that in the 1960ies when this diagram starts, humanity used about 0.7 planets. The red line represents the one planet that we have had since then, and the green line shows the increase in the total demand from 0,7 to 1,2 planets. The current demand means that we use more of the Earth's productivity than what can be regenerated. Every year we use the planet 1,2 times to fast. Or it would take one year and approximately two months to regenerate what we use within one year.

But how is it possible to use more biocapacity than there is on earth? How is it possible that we have an average footprint of 2, 3 hectares while only having an available capacity of 1,9 hectares, thereby running an ecological deficit of 0,4 hectares per person? It's quite simple. Consider the Earth like a big bucket. The sun replenishes it with its energy. The plants can grow and the excess or the surplus production is what we can use sustainably. Now what we do is that we use technology to access these resources more rapidly than they regenerate, thereby depleting the stock. Of course we could use technology to save resources, photovoltaic etc, but our economic model does not help us choose these kinds of technology. As you saw in the previous diagram, humanity's total demand for biologically productive space rose above the available biocapacity on Earth already in the end of the 1970:ies. Since then we have gone on harvesting forests at a more rapid rate than they regrow, catching fish more rapidly than they restock and filling the air with carbon dioxide from fossil fuel combustion faster than it is assimilated in growing biomass.

Much as we can compare the demand and supply of biologically productive space on a global level, we can look at individual countries or regions and compare the footprint with the locally existing biocapacity. As always, both footprints and local biocapacity are expressed in global hectares, i.e. hectares with average global productivity. A footprint that is larger than the national territory is possible to achieve in two ways: by local overshoot, i.e. by drawing on local ecosystem goods and services more rapidly than they regenerate, or by use of biologically productive capacities beyond the region at hand, i.e. by importing resources and thus indirectly importing biocapacity. The development of transport technologies and the global trade system is what has made such export and import of biocapacity possible. Interestingly, the regions that seem most susceptible to consume more than is available locally are the rich, industrialized regions. Vice versa, the more peripheral a region is economically, the more probable it is that its inhabitants cannot afford using even its own biological resources.

This table shows the balance between the footprint and the bioproductive capacity of high income, middle income and low-income countries. These numbers come from the Living Planet Report 2002, a footprint study in joint publication with the WWF, including all countries with a population larger than one million, which makes about 150 countries. The members of the richest countries have an average footprint of 6,48 hectares per capita, but the available biocapacity within their boundaries is only 3,55 hectares. These countries run an average ecological deficit of 2, 93 hectares per capita. The members of the middle-income countries have much smaller average footprints but the national biocapacities are still slightly overdrawn. The ecological deficit is 0,10 hectares per capita. In the low-income countries the footprint is much smaller, even

smaller than the available biocapacity, resulting in an exportable remainder of 0,11 hectares per capita. With the limited areas of bioproductive space of the Earth as our point of reference we understand that the growing footprint of the rich people on Earth is linked to the contraction of available space for the poor.

And it is unfortunately so, that despite the current overshoot and the unprecedented rise in levels of resource consumption of humanity as a whole, many people still do not have enough to sustain their most basic needs. According to UN statistics the richest fifth of the global population consumes more than 84% of Earth's resources, whereas the poorest fifth is left with only 1,4%. The footprint concept makes the linkages between the two more clear. It also reminds us of the fact that sustainability means meeting two difficult challenges simultaneously: On the one hand humanity as a whole must reduce its total footprint on the Earth. On the other hand the rich part of the global population must leave much more space for the poorer part to satisfy their material requirements. Not dealing with or not even daring to acknowledge the existence of both of these problems, may sharpen potentially destructive tensions, and put at risk the struggle for a sustainable future as a whole.

Now what options are available for remedying the ecological overshoot that we have exposed on the global level and the deficits that are especially significant in the case of the richer nations of the world? There are mainly three ways of going about. 1) We can put more efforts into increasing the biological productivity of the available spaces in a sustainable way. Permaculture is one promising example. 2) We can encourage smaller populations i.e. reduce the average family size. 3) We can reduce our resource consumption and thus also our footprints through more efficient use of resources and by adopting less material lifestyles. Different contexts demand different solutions. On some levels we can choose how much effort we want to put into each of these solutions in order to close the gap. Of course we can leave out one category, but this means we have to work harder in the others.

Nevertheless, I find it important to stress the third option must not be left out, at least not in the global discussion of sustainable development. Even if many rich people have lost faith in material happiness by now, the material way of life made possible for yet so few people on this planet is still a central part of the gospel of development. We need alternative visions of progress and possibly alternative definitions of it as well. Of course we all know that there are more important things in life than what can be expressed through our buying power, our *well-having*. Yet the ability to produce and consume things is given much more weight in the comparison between countries for example. After all, what does GDP say about *well-being*?

We all, most of us representative for the richer part of the global population, are probably aware of the shortcomings of one of the most commonly used indicators of progress. Still as representatives for our communities we are seldom free to criticize it openly. We are probably also all aware of the fact that we, in our representative roles may often do things that are associated with significant footprints. We could perhaps ask ourselves how big the total footprint of this symposium is, given all travel by air and the exquisite food and overall comfort that we've been offered onboard this ship. How many planets would be needed if all 6,2 billion people on Earth were living like we have been living during this week? I suggest that to truly meet the sustainability challenge presented to us by the ecological footprint concept there are three things we

need to do. 1) Find out about our own footprints. We can take the footprint quiz, available through the homepage of Redefining Progress. 13 questions and a few minutes of our time to compare our footprint with the available biological capacity on Earth. 2) Find out how to live well **and** lightly. This is the biggest research challenge We can explore how to even increase our quality of life while lightening our impact. It is possible, there are many examples including housing, better transport systems and – again - lifestyles that are more fulfilling while at the same time being less resource intensive. 3) And once we've said, OK we can do it! we can join the global effort and demand specific footprint goals. On all levels we can demand politicians and community leaders to be specific about and allow for the measuring of how our economy is doing with respect to our use of the limited biological capacity of the Earth.

Coming back to the current competition between countries on the basis of the commonly used indicator of GDP: if we really want communities and nations to compete against each other in some way, why not introduce a kind of competition that to my mind is more relevant in the context of the current ecological and social challenges? What if we invited all nations and different communities to participate in a contest regarding who can provide the highest quality of life for its members within the available average of 1,9 hectares per person on Earth? Of course the minimum high-jump may have to be even smaller if we anticipate a human population of 9 billion people in the next 30 to 50 years. Or possibly even less if we would agree to leave more space for other creatures of this creation; elephants, tigers, whales, eagles or beetles in the Amazonian forest. In any case, for the relation between humans and particularly our international relations it would already make a huge difference if we could all agree to meet the present, more conservative challenge: Who can be the most happy community while reducing the average footprint size to 1,9 hectares or less? The nicest thing about such a competition would be that the winners would not win at the cost of the others, on the contrary, they would excel through an act of solidarity with both present and future generations on Earth.