Ecological Footprints: A Tool for Advancing Sustainability

Slide 1-Introduction

- Welcome to a short walk through the realm of sustainability.
- In the next 30 minutes, dinosaurs, cows, and mermaids will help explain how we can live better and use less nature. Why does this matter?

Slide 2 with growth trends since 1950:

- Since the 1970s, one report after the other has warned us of the danger of continuous human expansion.
- Each year we produce more material things, using more energy and resources, and discarding more waste.
- Since World War II, human activities have grown five to seven-fold.
- One factor in this expansion is increased consumption, particularly in rich countries, while another is population growth.
- Today, these growth trends continue. Humanity keeps extending its activities to leave ever bigger imprints on the planet.

Slide 3 with a bursting house on squeezed planet:

- In consequence, the size of the human enterprise has become large in comparison to the biosphere.
- In fact, much evidence indicates that we are reaching ecological limits.
- As we grow every year, we live in a riskier world, a world with more consumption, more waste, more people, more poverty, and more carbon dioxide in the atmosphere . . .
- but with less biodiversity, less forest area, less available fresh water, less soil, and a thinner ozone layer.

Slide 4: What is SUSTAINABILITY?

- This combined social and ecological tension will define our common future.
- There are many ways to define SUSTAINABILITY, and your packet includes a huge list of them.

Slide 5: Read definition and click through Slide 6 to . . .

Slide 7: Wackernagel definition . . .

- Mathis Wackernagel (the originator of the ecological footprint tool) says it this way: *"We need to find ways to secure satisfying lives for all within the means of nature — this is the sustainability challenge. Not living within our ecological means leads to the destruction of humanity's only home. Injustice and being denied a satisfying life will cause conflict and destroy our social fabric."*

- Unfortunately, what is not measured does not count. In consequence, to make sustainability happen, we need to know both whether people's quality of life improves and how much nature we use.
- Like any individual or organization, we need to keep books about what we add and take from our assets. Otherwise we lose control.
- The most fundamental asset we depend on is nature.
- Therefore, we need to keep track of how much nature we have and how much nature we use. Only then can we monitor whether we live within our ecological means and know how far off we are.
- Luckily, in the last few years, we have made substantial headway in the development of such monitoring tools.

Slide89 with people overusing the natural capital of the Earth:

- Let's approach the sustainability equation from the ecological side first.
- To be sustainable, we must not diminish nature's capacity to generate and regenerate its functions and services.

Slide 9 – What is Natural Capital?

- Ecological economists call this "maintaining the natural capital." This capital, they concede, is our ultimate source of wealth.

Slide 10: Square footprint w/list of types of capital

- An economy needs four types of capital to function properly: HUMAN, FINANCIAL, MANUFACTURED, NATURAL
- The next two slides list many of the ECOSYSTEM SERVICES provided by nature (OUR NATURAL CAPITAL).

Slide 11 & 12: ecosystem services (click through them)

Slide 13: with the water bucket analogy of sustainable use:

- What does constant natural capital mean?
- Imagine a bucket being filled with water at a fixed rate.
- The water in the bucket is a capital stock that can be used only as rapidly as the bucket is being refilled.
- This balanced withdrawal rate represents sustainable income.
- Similarly, nature's "bucket" is continuously replenished by the sun.
- The sun powers photosynthesis and the resulting plant matter builds the foundation for all food chains.
- It also keeps climatic, hydrological, and other biophysical cycles running.
- Sustainability implies that nature's capital should be used no more rapidly than it can be replenished (right).

- However, trade and technology have enabled humankind to progressively exploit nature far beyond sustainable levels so that present consumption exceeds what nature can regenerate.
- This leaves the next generation with depleted natural capital and less productive potential, while at the same time human population and material expectations are still on the rise (left).

Slide 14 with dinosaurs:

- A basic scientific concept enables us to measure our use of nature. Let's identify it by analyzing this picture of dinosaurs.
- The slide shows an illustration that could come from any popular dinosaur book for children.
- However, more than about dinosaurs, these pictures reveal something about our dominant culture. Why?
- Because they all commit the same error of ignoring a basic ecological concept. What is wrong with this picture?
- Of course, people interested in biology will immediately realize that there are far too few plants in comparison to the number of dinosaurs.
- This picture omits the concept of carrying capacity. What we see here is a non-depletable marketplace of "Dinosaur City" packed with animals shopping for food.
- However, if we could have a photograph of the actual time of the dinosaurs, taken from a mountain top, it would show lots of landscape and — if we were really lucky — a few dinosaurs here and there. Being large, these beasts needed extended habitats to sustain themselves.
- Our culture is well-practiced at ignoring carrying capacity: most of us live in cities where we get our food and products from stores that are constantly restocked.
- Shops actually replenish faster than shoppers can empty them. Similarly there is no immediate limit to the electric energy we can get out of the socket, the gasoline we can buy at the gas station, or the waste we can dispose.
- Advertising also fosters this illusion of limitlessness by depicting an abundance of lush, endless landscapes.
- In essence, we have built powerful cultural barriers that make ecological limits invisible and separate us from the reality of the finite bio-productive capacity of nature.

Slide 15 with deer in a habitat:

- What is carrying capacity?
- Biologists define it as the maximum population of a species that can be sustained indefinitely in a given habitat.
- Some shrewd analysts argue that carrying capacity does not apply to people and they point to two examples: Hong Kong has a reasonably high standard of living without any ecological capacity, while Ethiopia, with extensive land area, has suffered famines.
- These analysts may therefore conclude that human wealth is created independently of any ecological capacity.
- However, there is a twist.

- People, like all other animals, depend on nature's steady supply of the basic requirements for life: air, water, and food. In addition, we use energy for both heat and mobility, wood for housing, furniture, and paper products, fibers for clothes, ecological sinks for waste absorption, and many life-support services for securing living conditions on our planet.
- However, in contrast to most other animals, people consume resources not only from their own region, but virtually from all the globe's ecosystems.

Slide 16 with a person on the upside-down deer habitat:

- Therefore, we need to turn the carrying capacity question upside down.
- The question is not how many people can live within a region, but rather how much land, or how much ecological capacity, is necessary to support a given population.
- In other words, not number of people per area, but area claimed by people to maintain their level of consumption.

Slide 17 with an economy's metabolism hovering over a cow's pasture:

- In fact, any human economy, city, or household is an ecological organism much like the cow on the pasture.
- To maintain itself, the economy needs to "eat" resources, and eventually all this intake becomes waste and has to leave the organism again.
- So the question becomes: how big a pasture is necessary to support that economy — to produce all its feed and absorb all its waste?
- Alternatively, how much ecological capacity would be necessary to sustainably support a **defined economy at its current material standard of living?**

Slide 18 with some houses on top of a foot:

- Since we can account for all the resources consumed and waste produced, the human use of nature is measurable.
- This ecological capacity necessary to sustain people's activities we call humanity's *ecological footprint*.
- We define it as the biologically productive areas necessary to continuously provide the resources used by a given population and absorb their wastes, using prevailing technology.
- To add up a population's footprint, we need to know its consumption of food, fibers, and energy, and the corresponding waste.
- For each category, foresters, agricultural scientists, and biologists can tell us the ecological spaces necessary to provide the material or to absorb its waste.
- For example, we know how much timber or how many potatoes can grow on a hectare each year.
- Adding up all these bio-productive areas occupied by human consumption, we get the ecological footprint.
- One person's ecological footprint can be anywhere from .5 acre for people living very simply on subsistence permaculture, up to more than a 29.6 acres for people with energy- and material-intensive industrial lifestyles.

- In fact, as we will discuss a bit later, people living in industrialized countries occupy, on average, between 10 and 25 acres per person.

Slide 19 with Earth divided into segments of biologically productive areas:

- Before analyzing how much bio-capacity we require, let's look at how much there is on our planet.
- The Earth has a surface area of 51 billion hectares. Some of these surfaces, such as arable land or forests, are highly productive; others areas are too dry, too wet, too cold, or too hot. To illustrate the amount of biological capacity on the planet, we have arranged them according to their productivity:
- 71% percent is covered by oceans. The bulk of the oceans' 4% biologically productive area is concentrated mostly on continental shelves in coastal areas.
- Twenty-nine percent is land. However, only 18% of this land is biologically productive. The remaining 11% is marginally or entirely unproductive for human use, of which much is covered by ice.

Slide 20 with our personal island:

- What does this mean at the individual level? This "personal island" represents the mathematical average of biologically productive space that exists per person on Earth.
- It is the total bio-productive area divided by the number of people in the world. This "island" would cover 3.7 acres. If the island were a circle, it would have a diameter of a little less than 164 yards.
- One-sixth of each person's island would be arable land, the rest would be pasture, forest, wetland, and built-up area. In addition, there is about half a hectare of ecologically productive sea space. Together this adds up to 5.4 acres of bio-productive space per person.
- However, we are not alone on this planet. We share it with perhaps 30 million other species — most of them excluded from the spaces we occupy so intensively for human purposes.
- For example, in agriculture any species that is not exploitable is called a "weed", and with urbanization much of the most fertile land is paved over.
- Now we would like to ask you, how much of the bio-productive area should we leave relatively untouched for these other 30 million species?
- How much would be fair?
- How much would you feel is necessary to secure an ecologically stable world?
- Who thinks that we should take more than two-thirds of the capacity?
- Even in the case of leaving only one-third to the other species, we can occupy, on average, not more than 1.5 hectares out of the 2.2 that exist per person on the planet.
- Therefore, the sustainability challenge then becomes: *How can we secure people's quality of life within the limit of 3.7 acres per person?* This is probably the most significant question we are faced with in research, business, and politics.
- Let's remember these 3.7 acres as a reference point.

Slide 21 with the historical development of footprint sizes and personal islands:

- What happened?
- Almost throughout this century, and in spite of technological wizardry, people's footprints in industrialized countries have kept growing, while our personal islands continue to shrink.
- They shrink in proportion to the number of people on the planet, and to the loss of bio-capacity.
- Since the beginning of this century, the existing bio-productive space on the planet has decreased from close to 22 acres per person to 2.2 [CHANGE] in 2000, of which a bit more than 3.7 acres are on the land.
- Once humanity reaches ten billion people, as is expected in the year 2030, the available ecologically productive space will have shrunk to 3.2 acres per person.
- At the same time, the average footprint of urban industrial people is now between 10 and 25 acres, whereas in 1900 it was approximately 3.7 acres and in 1950 it was about 6.2 acres.
- These opposing trends are in fundamental conflict: the ecological demands of average citizens in rich countries exceed the *per capita* supply by a factor of three to seven.
- This means that the Earth could not support today's population of six billion sustainably at the material standards of today's industrialized countries.

Slide 22 with four planets:

- Perhaps humanity should put an ad in the intergalactic newspaper: *Wanted: Three More Livable Planets.* If everybody lived like today's industrial urbanites, it would take at least three additional planet Earths to produce the resources, absorb the wastes, and otherwise maintain life-support.
- Unfortunately, good planets are hard to find, even with large NASA budgets. Still, there is no reason to despair. As we will see later, there are many ways we can significantly reduce our footprints while still maintaining a high quality of life.

Slide 23-29: Worldwatch 2004 Global Natural Resource and Environmental Trends

Slide 30 with a list of the world's biggest footprints [blue text slide]:

- This list shows the nations with the largest ecological footprints. All numbers are given in acres per person of world average bio-productive area. This makes them directly comparable.
- If we want to know the total footprint of a nation, we just need to multiply the per capita figure with the number of its inhabitants. New Zealand, Canada, Australia, and the United States are leading in unsustainability with footprints between 18.5 acres and 25 acres per person.
- Icelanders' footprints on the land are not much different from those of their European colleagues. However, their dependence on the sea is far larger: they consume ten times more fish than the world average.
- The smallest footprint on this list, the United Kingdom, is 11.4 acres per person, still over three times larger than the 3.7 acres within which the average human footprint should fit worldwide.

Slide 31 with the Italian boot walking on the planet Earth:

- There it is, the Italian footprint as seen from outer space. The Italian's average footprint is slightly smaller than that of its European neighbors – 10.4 acres per person.
- One reason may be the way Italians are housed: many of its historic cities are still intact and offer high-density living. The population is hardly growing, which slows down construction activities, and Italy's winters are milder than in Northern Europe which means less energy is consumed for heating.
- Another reason for the size of the footprint is Italy's lower purchasing power, particularly in the south.

Slide 32 – with a list of the world's smallest footprints [blue text slide]:

- Only nine out of the 52 countries analyzed here use less than the identified 3.7 acres per person. If everyone had footprints like these nine countries, humanity would still fit ecologically on this planet.
- But small footprints do not necessarily imply a low quality of life. In the south of India the State of Kerala with 30 million inhabitants is a particularly inspiring example. In spite of modest footprints of 2 acres per person, the people of Kerala enjoy demographic stability, low child mortality, longevity, and high literacy rates, all comparable to the much richer industrialized countries. Also, they can pride themselves on a lively democracy and the active participation of women. What they achieved with hard work and vision
- In the past is an answer to the challenge of tomorrow: how to squeeze lots of quality of life out of small footprints. Hopefully they are willing to coach us with their valuable sustainability experience.

Slide 33 with a Mexican city on top of a foot which is placed on Central America:

- Why should the Mexicans (as shown on this footprint) or any other Southern country care about footprints?
- Globalization has proven effective in catering to the wealthy countries' short-term interest. The current structure of trade has allowed them to get hold of resources cheaply and rapidly from all over the world.
- The more easily they can access resources, the better these rich countries can defend their privileged position in the global economy.
- Since this kind of economy accelerates the gobbling of resources with little benefit to people with low incomes (in contrast to claims by many governments), Southern countries may well be better off to be more protective of their natural capital.
- Their challenge is how to secure their people's quality of life with their natural capital stock. Exporting the resources may be one possible strategy, but export merely for the sake of export earnings (as promoted today) should not be the driving development strategy.
- This conventional thrust only produces fast cash through natural capital liquidation. In other words, such development diminishes the nation's total wealth once we take into account both the human-made capital and the natural capital.

- Thinking from a footprint perspective becomes essential for designing more prosperous development schemes that further the national interest. It enables such plans by measuring the bio-capacity available for social development.
- Also, it can compare this eco-capacity to the actual resource consumption and waste production of the country. Development informed by a broader understanding of wealth becomes even more urgent for Southern countries like Mexico that have already exceeded their national carrying capacity and are starting to liquidate their natural capital stock at an even faster rate.

Slide 34 Largest ecological deficits

Slide 35 with footprint "carpet" covering the globe:

- However, even humanity as a whole is living off an ecological deficit. Our calculations show that the ecological footprint of humanity is about one-quarter larger than the biologically productive space that exists on the planet.
- If we were to protect one-third of the biosphere for other species, the overshoot would be even larger — over 80 percent, to be precise. This means that humanity's consumption is 80 percent larger than humanity's share of nature can regenerate on a continuous basis.
- How can humanity's footprint be larger than the bio-productive space available on the planet? The situation is not unlike the way in which we use financial capital.
- Withdrawing less than the interest protects the capital; taking more, erodes the capital stock. Similarly, by using more than nature can regenerate, we diminish and weaken the planet's natural capital.
- The ominous costs of overshoot strike back in a delayed fashion. Therefore, people in both the North and South encounter few immediate barriers to depleting natural capital beyond its regenerative capacity.
- In fact, a product made out of liquidated or mined natural capital (unsustainable) is virtually indistinguishable from one made out of natural capital's interests (sustainable).
- Only at the macro scale of the region or the globe do the cumulative effects of ecological overuse become evident. As long as the trespassing of sustainable limits goes unnoticed, people will not perceive in a meaningful and personal way the urgency of avoiding overshoot.
- It is still so much easier to dig into the global biospheric "chocolate cake", particularly as globalization, inexpensive communication, cheap transportation, and industrial ingenuity provide us with bigger and handier spoons.
- By helping us visualize the eating up of our biospheric "chocolate cake", footprints may help us anticipate the real associated costs and lead us to make wiser choices.

Slide 36 with two people on a large piece of land and eight on a small one:

- Even though the footprint of humanity has exceeded global limits, some people may still need a bigger share to secure their basic needs. According to our rough estimates, 20 percent of the world's population is occupying around two-thirds of the global footprint.

- If we leave one-third of the bio-capacity for other species, humanity is already using over 80 percent more than can be regenerated by nature. Therefore, the share of the wealthiest 20 percent adds up to using two-thirds of 180 percent of the biosphere's capacity — this is 120 percent of what could be used sustainably.
- So if the rich were to be able to get rid not only of poverty, but also of all the poorest 80 percent of humanity (for example by sending them to Mars), the remaining rich 20 percent would still be in overshoot.

Slide 37 with a balance of two lifestyles:

- In today's ecologically overloaded world, we are all in competition for the finite flow of natural income produced by the ecosphere.
- In "ecological footprint" terms, excess consumption by the affluent occupies ecological space that would otherwise be available to the poorer segments of humanity.
- If we measure wealth or standard of living only in monetary terms, we remain blind to absolute limits.
- The impact of one person's wealth on other people's possibilities is not immediately apparent.
- Economists claim that wealth creates opportunities for more wealth. However, the ecological reality is another one.

Slide 38 with a foot that is squeezed by a belt:

- One thing is obvious: humanity as a whole needs to reduce its resource consumption and waste production. However we need to do it in a way in which the quality of our lives is also secured.

Slide 39 with/writing:

- Only those projects can move us toward sustainability which (a) reduce humanity's ecological footprint and, at the same time, (b) secure or even improve people's well-being.
- If people feel worse off through new sustainability initiatives, they will oppose them. How is it possible to combine these seemingly contradictory strategies?

Slide 40 with a piece of land with a house floating over it, connected through three steps that help reduce our footprint:

Let's first look at three complementary strategies to reduce our ecological footprint. We can:
(1) Sustainably improve the bio-productivity of nature. Examples of these improvements include permaculture, the use of careful irrigation in agriculture, cover crops to protect soil or terraces on mountain slopes, reforestation, and the use of solar energy on unused roof areas. Our harvests and services per hectare would increase.
(2) Better use the harvested resources by using less input to produce the same output, also known as eco-efficiency. Examples include energy efficient lamps, heat pumps, recycling, and climate-adapted architecture. Switching from electricity to solar power for heating water is a particularly dramatic example, since it reduces the corresponding footprint 1,000-fold.

(3) Consume less by consuming less per person and by being fewer people. To consume less we can, for instance, avoid car use and the purchase of disposable products. This way we can both save money and gain leisure time. A simpler lifestyle may also put less strain on our health and help us enjoy our lives more.

- Remember: all these strategies must also make the affected people feel more satisfied.

Slide 41 with a house and a person on a foot:

- A useful characteristic of the footprint is that it can be applied to every scale, thereby linking the global with the local. We can analyze the footprint of humanity, a nation, or a city.
- We even can calculate the footprint of a household or a single product. For assessing the household's footprint, all you need is a scale near the entrance to your home, a booklet to record your consumption, a sheet with conversion ratios, and a pocket calculator.
- In fact, the students of a number of university courses in Europe and North America have already used this method to trace their own footprints and extrapolate what would happen if everybody in the world lived like them.

Slide 42 with photo of Mathis sitting on a big stone foot:

- Luckily, the path to sustainability is blessed with good news and... good news.
- First, the bottom line of sustainability can be stated quite simply and clearly: *humanity needs to secure everybody's quality of life within the means of nature.*
- These means of nature are quite specific and identifiable, and thus measurable.
- As we mentioned earlier, there exists today 5.4 acres of bio-productive space per person on this planet. If we leave a meager third to the other 30 million species, we can use on average 3.7acres per person for our purposes.
- As challenging as this number is, the good news is that we know explicitly what is needed for sustainability and that we can measure our progress. We are back in control.

Slide 43 with people enjoying themselves in the outdoors:

- The second piece of good news is even better.
- There is a lot of evidence that we can *improve* the quality of life while living on a reduced footprint.
- While we concede that a reduction in footprint does not necessarily improve quality of life, there are many inspiring examples at the individual and social level which show very high health status at low footprints (such as in the State of Kerala) or significantly improved quality of life at significantly reduced footprints (see examples gathered by the New Road Map Foundation).
- Many people have realized that the best things in life are not material things and they have found joy in activities that consume little of the Earth's splendors.
- For example, rebuilding human communities may help us find happiness and security without having to accumulate large amounts of material wealth.
- What is happiness, really? This most basic philosophical query is also the opening question to sustainability.

- The heroic venture for tomorrow is to find ways of achieving happiness by consuming less. Many have shown that it is possible. Whether or not it is probable depends on us.
- Certainly, a sustainable world cannot be constructed by attitude changes at the individual level alone.
- There are severe institutional obstacles that we need to remove or overcome through a collective effort.
- However, to develop the collective momentum for building new social contracts, we need motivations and visions which accompany and encourage us.
- We need grounded visions and enthusiasm about the possibility of living in such an imagined world.
- Once we have a clear view of what we would like to achieve, it is easier to identify the obstacles, develop strategies, and invite those in our sphere of influence to join forces in making the world sustainable.
- To live well tomorrow requires sustainability today. No doubt society will have to make significant transformations — and the longer we wait the harder it may get. The good news is that it is still possible to create a sustainable world which that secures equitable and decent living within the means of nature. Ecological footprint analyses may help us. These footprints are not about how bad things are, just how things are and what we can do about it.

Slide 44 Living Planet Report (2002)

Slide 45 Graph of Humanity's Use of Earth (from Living Planet)

Slide 46 More graphs

Slide 47 Your Ecological Footprint? www.myfootprint.org