

# **Economics and Sustainability: Conflict or Convergence?**

**(An Ecological Economics Perspective)**

Originally prepared for a presentation

by

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# Economics and Sustainability: Conflict or Convergence?

## (An Ecological Economics Perspective)<sup>1</sup>

### ***Sustainability Through Expansion: Introducing the Modern Myth***

One of the most enduring myths of industrial (and even post-industrial) society is that we moderns, products of the enlightenment all, no longer live in the light and shadow of myth. In fact, nothing could be more illusory. True, modern science has purged a virtual library of shadowy beliefs from our own culture and erodes the cosmological underpinnings of every other society with which it comes into contact. But the equation of myth with mere falsehood, superstition, and the unscientific beliefs of ‘primitive’ people belies a shallow and sterile view of myth. Myth is a universal property of human societies and plays a vital role in every culture.

This assertion becomes easier to accept when we consider Colin Grant’s conception of myths “not as mistaken views but as comprehensive visions that give shape and direction to life.” In this light, myths “move from being dispensable misunderstandings to essential categories that we all take for granted” (Grant 1998, 1). Anyone who has lived through the past few decades and even occasionally read the papers will instantly recognize, that by this definition, the entire world has succumbed to a common myth of uncommon power. Virtually all ‘official’ international agencies and national governments share a comprehensive vision of global ‘sustainable development’ centered on unlimited economic expansion and fuelled by more liberalized trade. At the heart of this expansionist vision (also called the ‘dominant economic paradigm’) is the belief that human welfare can be all but equated with ever-increasing material well-being (income growth). This contemporary myth has been the principal force giving shape and direction to political and civil life in both industrialized and so-called developing countries on every continent at least since the 1960s.

Consistent with the myth, most so-called development policy is aimed at promoting the rapid growth of national economies and gross world product. The doctrinal authority for the expansionist vision is drawn from neoliberal (neoclassical) market economics. Neoliberal models promote the untrammelled marketplace as the most efficient way of increasing production/consumption and global free trade as providing the largest—and most profitable—possible market. This approach naturally diminishes the role of government, elected or otherwise, since any interference in the workings of the market is, by definition, inefficient. It also encourages the transfer of significant power to international regulatory agencies and transnational corporations, both of which remain unaccountable to the people they supposedly serve (Korten 1995).

Like all abstractions, the market myth/model simplifies reality—for example, it transforms decent well-rounded citizens into gluttonous single-minded consuming machines. The resultant *Homo economicus* is defined as a ‘self-interested utility maximizer with immutable preferences and insatiable material demands’ (definitely not the type of person one might invite home to dinner!). You and I are assumed to act as isolated automatons whose sole goal is to maximize our personal consumption through participation in the increasingly global marketplace. The market model cannot accommodate the concept of ‘family’ and relieves our morally diminished *Homo economicus* of any other responsibility to society. (In Margaret Thatcher’s ice-cold phrase, “There is no such thing as society.”)

Note that the doctrine of unlimited growth conveniently sidelines the irritating ethical arguments for wealth redistribution that might otherwise apply on a finite planet. Convention has it that in an ever-expanding economy even the poorest of the poor will eventually enjoy a materially adequate life. A cleverly picturesque metaphor—‘a rising tide raises all ships’—serves also to drown the opposition. Significantly, too, expansionists see no fundamental conflict between economic growth and ecological degradation. (This aimed to hearten those interested in biological integrity.) Indeed, they argue that that chronic poverty in the developing world is a primary cause of ecological decay and that the only sure way to eliminate poverty and repair the environment is through growth (Beckerman 1992, WCED 1987).

This is a satisfying myth for denizens of the industrial world and the so-called ‘emerging economies’ alike. The popular culture of high-income countries persuades us that greed is good and that we can indulge our wildest materialist fantasies free of social guilt or ecological recrimination. Even better, theory says that by consuming goods

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<sup>1</sup> Based in part on Rees (1995) and Rees (2001b)

produced or manufactured in the developing world, wealthy northerners contribute to improved welfare in the impoverished South. All this while producing the wealth allegedly required to restore the planet.

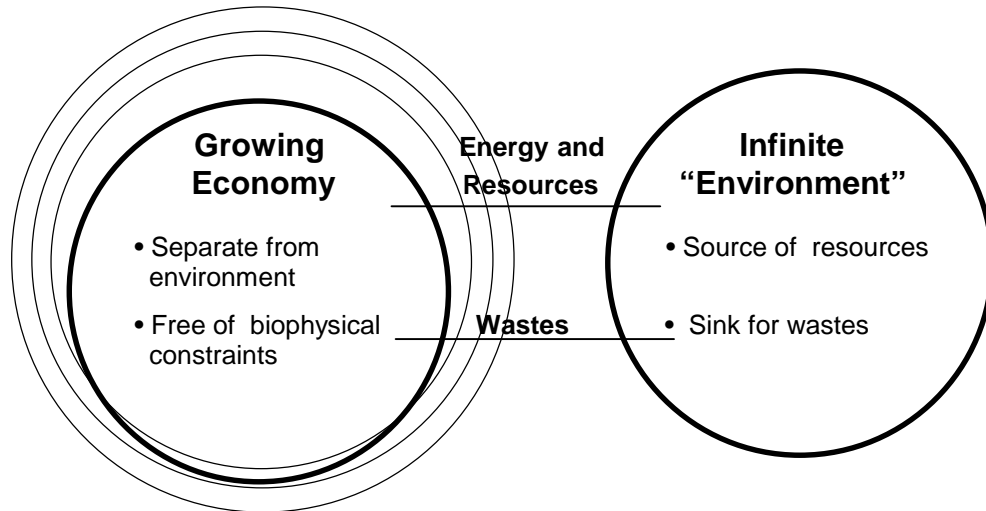
But is sustainable development really this easy, we merely have to stick with the *status quo*? The purpose of this presentation is to examine the prevailing development myth in light of both empirical evidence and an alternative perspective rooted in so-called 'ecological economics.' What are the primary assumptions associated with expansionism as a model for sustainable development? Are these structural assumptions valid? What do real-world trends have to tell us? And finally, what might an alternative development framework based on material human ecology look like?

## **Dissecting Expansionism**

As noted, the expansionist myth is closely associated with neoliberal economics. This conception of the economic process treats the economy as an independent, self-regulating and self-sustaining system whose productivity and growth are not seriously constrained by the environment (Figure 1.) Adherents believe that humankind has achieved mastery over relevant parts of the natural world and through technology will be able to compensate for the depletion of any important natural resources. Even the UN's ground-breaking World Commission on Environment and the Economy (the Brundtland Commission) can be placed in this camp. The Commission assumed that any limits on the environment's ability to meet human needs were imposed not so much by nature as "by the state of technology and social organization" (p.43) and that while future expansion would have to be qualitatively different from present forms of growth, "a five- to tenfold increase in world industrial output can be anticipated before the population stabilizes [at about twice the present numbers] sometime in the next century"(WCED 1987, p.213).<sup>2</sup>

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**FIGURE 1: The Expansionist Perspective**



Expansionists treat the economy as an open, growing, independent system which, because of technological innovation, lacks any fundamentally important connectedness to the 'environment' (which is therefore treated as infinite).

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<sup>2</sup> Ironically, some members of the expansionist school regard the Brundtland Commission as being excessively "nervous" about the state of the natural world (see Nordhaus 1992). Being seen by conservative economists as relatively radical and by hardcore environmentalists as excessively conservative is evidence of the fine line walked by the Commission and of the ambiguity inherent in the "sustainable development" concept it popularized.

Prevailing economic rationality relies heavily on the assumed simple mechanics of free and open markets to ensure sustainability. This naturally leads to great emphasis on “internalizing the externalities” (waste disposal costs) and “getting the prices right” (privatizing and pricing nature’s ‘goods and services’) as an essential first step. Many conventional economists place great confidence in price as an indicator of scarcity and on the mechanics of the marketplace to relieve it – rising prices for scarce resources automatically lead to conservation of the affected resources and stimulate the search for substitutes. And as Nobel Laureate Robert Solow has observed: “If it is very easy to substitute other factors for natural resources, then... The world can, in effect, get along without natural resources...” (Solow 1974, 11). (Solow’s is actually a fairly *conservative* statement of what has become the near doctrine of ‘near-perfect substitution’. Julian Simon’s ebullient optimism tosses Solow’s cautionary ‘if’ to the winds: “Technology exists now to produce in virtually inexhaustible quantities just about all the products made by nature...,” and “We have in our hands now... the technology to feed, clothe, and supply energy to an ever-growing population for the next seven billion years...” [Simon, cited in Bartlett 1996]). In contemporary mythology, the cornucopia of human ingenuity has clearly displaced nature as the great provider.

In fact, market forces and substitution seem to be working, at least for commonly traded non-renewable resources. With the exception of timber, the real prices of all resources examined—including rural land—show a significant drop over a century-long period implying *increasing* economic availability (Barnett and Morse 1963), although a leveling of this trend may have occurred around 1970 (Nordhaus 1992). Since real prices for appropriable resources show no major turn toward scarcity, economists generally “tend to be at the relaxed end of the spectrum” of those concerned about environmental constraints on growth (Nordhaus 1992, 5).

It follows that sustainability is a fairly simple business from the expansionist perspective. If there are no general environmental constraints on the economy and we can find technological substitutes for particular resources, then the shortest route to sustainability is to stay our present course. If we continue freeing up markets, privatizing resources and government services, and eliminating barriers to trade, a new round of growth in both rich and poor countries will provide the wealth needed both to redress poverty and inequity and to generate the economic surpluses needed, particularly in the developing world, better to husband the natural environment (see Beckerman 1974 for a full exposition). In short, mainstream thinking holds that “...the surest way to improve your environment is to become rich” (Beckerman 1992, 491 as cited in Ekins 1993, 267).

## Mything Out on Reality

Critics find several flaws in expansionist theory that suggest, *a priori*, that it would make a poor foundation for global sustainability. And the critics I am talking about are not the radical environmentalists, leftist ideologues, or professional protesters that are so readily dismissed by the mainstream media whenever discussion of growth-through-globalization-and-trade comes up. The sharpest barbs come from professional and academic economists themselves, well-versed in both the theory and practice of conventional economics. Their critique is concrete and comprehensive. Some examples:

### 1) *The fallacy of misplaced concreteness*

Those living a myth are the least likely to see it for what it is. As John McMurtry observes:

[Like] other social value programs, the doctrine of ‘the global free market’ itself does not recognize its ideology as ideology, but rather conceives of its prescriptions as ‘*post-ideological*’ recognition of law-like truth (original emphasis)... The truth of the global market order is believed to be final and eternal, ‘the end of history’. Its rule is declared ‘inevitable’. Its axioms are conceived as ‘iron laws’. Societies that dare to evade its stern requirements are threatened with ‘harsh punishments’ and ‘shock treatments’ (McMurtry 1998, 43).

The brand of global absolutism described by McMurtry actually reflects a peculiar characteristic of neoliberal economics. Most disciplines test their models against the real world and then adapt the models the better to reflect reality. By contrast, the economists’ myth is so entrenched that its devotees presume to force reality to conform to their models. If real-world *Homo sapiens* does not behave quite like *Homo economicus*, this “does not make the basic model wrong, as it would in every other discipline. It just means that actions must be taken to bend *Homo sapiens* into conformity with *Homo economicus*. So instead of adjusting theory to reality, reality is adjusted to theory” (Thurow 1983, 22-23). In short, society has come to take its economic model more seriously than reality!

## **2) Maximizing income does not maximize well-being**

Although economists seem strangely silent on the matter, extreme ‘free-market’ thinking as applied by international agencies and many governments actually perverts sound economics. Sound economic theory would, indeed, have us maximize welfare, but recognizes that production/consumption is only one factor in the equation. A healthy environment, natural beauty, stable communities, safe neighbourhoods, economic security, social justice, a sense of belonging, and countless other life-qualities contribute to human well-being. Thus, to the extent that people value any of these *public* goods more than they might value their next unit of material consumption, forgoing additional production/income growth to obtain these goods (eg, through taxation or other means of income redistribution) would actually be sound economics—it would increase net social welfare (Heuting 1996).

The point is that in different circumstances the technologies and tendencies to globalization (if not the expansionist version) could be turned to enhancing not only income security, but also many other values that make life worthwhile. By contrast, available data suggest that the current approach to international development may actually be destroying more unmeasured yet real economic value, much of it in the common pool, than is being accumulated by private interests. If so, this is gross market failure. In a total social cost/benefit framework, it is clearly uneconomic to allow the destruction of two dollars worth of resources or the global commons so that some individual or firm can realize one more dollar of profit. Sound policy would give governments a legitimate role in protecting and enhancing the public interest whenever the market fails to do so. Yet, in today’s world, government intervention in the economy is reviled – globalists all sing in the deregulation choir.

## **3) The myth does not map to physical reality...**

The expansionist myth is rather too cavalier with physical reality. This problem begins with the basic structure of the simple mechanical economic models upon which expansionism is based. The conceptual starting point for conventional economic analysis is the “circular flow of exchange value” (Daly 1991a, 195). Most standard economic textbooks feature a standard circular diagram of economic process as “a pendulum movement between production and consumption within a completely closed system” (Georgescu-Roegen 1971). Value embodied in goods and services flows from firms to households in exchange for spending by households (national product). A supposedly equal value, reincarnated in factors of production, flows back to firms from households in exchange for wages, rents, profits, etc., (national income).

Significantly, this model is totally abstracted from the ‘environment’ within which the money economy is actually embedded—there are no connections between the money flows and biophysical reality. It is therefore “impossible to study the relation of the economy to the ecosystem in terms of the circular flow model because the circle flow is an isolated, self-renewing system with no inlets or outlets, no possible points of contact with anything outside itself” (Daly 1991a, 196). By definition, then, the most fundamental neoliberal model lacks any representation of the materials, energy sources, physical structures and time-dependent processes that are basic to understanding ecosystems structure and function (Christensen 1991). Worse, the implied simple, reversible, mechanistic behavior of the economy is inconsistent with the connectivity, irreversibility, and positive feedback dynamics of complex energy, information, and eco-systems, the systems with which the economy interacts in the real world.

## **4) ...nor to real-world markets**

Standard economic models are scarcely better at representing real-world market behavior, ostensibly their most legitimate domain. We have already noted that *Homo economicus* displays a grotesquely limited caricature of real human behaviour but the problem is more fundamental. In particular, mainstream market models are based on the concept of ‘general competitive equilibrium’, a prominent distinguishing feature of which is that it bears little relationship to the real economy (Ormerod, 1997). Theoretically, a free-market competitive equilibrium is optimally efficient—that is, demand equals supply in every market (markets clear) and all resources are fully utilized. Moreover, at equilibrium, no individual or firm can be made better off by altering the allocation of resources in any way without making someone worse off (Pareto optimality). (Thus, by definition, any government intervention in the marketplace in defense of the public interest would be inefficient.)

However, even this stunted theoretical ideal depends upon the following critical assumptions...

1. diminishing marginal returns in consumption and production;
2. perfect competition among a hyper-infinite continuum of traders (buyers and sellers) none of whom can individually influence prices;
3. all traders have perfect knowledge of all present and future markets;

4. an infinite number of future markets.

...and none of these necessary conditions obtain in the real world. Ormerod concludes that ‘...there appear to be so many violations of the conditions under which competitive equilibrium exists that it is hard to see why the concept survives, except for the vested interests of the economics profession and the link between prevailing political ideology [the ‘myth’ again] and the conclusions which the theory of general equilibrium provides’ (Ormerod 1997, 66).

### ***5) and the problems run much deeper (and wider)***

James K. Galbraith makes a similar but more general point in a devastating critique of the year 2000 meeting of the American Economics Association. He observed that discussion of the “great issues of economic policy” were missing from the program despite the fact that the empirical evidence “flatly contradicts” each of the five leading ideas of modern economics. Galbraith takes this ‘disconnect’ from the real world as evidence that “modern economics... seems to be, mainly, about *itself*” (Galbraith, 2000, p1, original emphasis). He goes on: “But self-absorption and consistent policy error are just two of the endemic problems of the leading American economists. The deeper problem is the nearly complete collapse of the prevailing economic theory... It is a collapse so complete, so pervasive, that the profession can only deny it by refusing to discuss theoretical questions in the first place” (Galbraith, 2000, 4).

Despite such unqualified condemnations of prevailing economic theory by economists themselves, its pattern of thinking spills over into adjacent social sciences. In political science, for example, it is increasingly the pure elegance and artificial neatness of models, not their relation to real world activities, that reap the greatest rewards for academics. “In short, political science is sanctifying a chalkboard universe inhabited by ‘*Homo economicus*,’ which, in the name of utility maximization, tries to erase all trace of culture, history, personality or any quirky quality that might smudge the one size fits all model (Jacobsen 2001).

## **What Does the Real World Tell Us?**

Given the apparent mismatch of theory and ordinary experience, a reality check seems in order. How has misplaced concreteness played out? What is the state of the global economy? Is everyone better off? And how goes the ecosphere?

### ***1) The economy balloons...***

First, the (qualified) good news. There can be little doubt that globalization and freer trade has been a strong stimulus to production growth and gross world product. The global economy has expanded five-fold in the past half century, three-fold since 1980 alone. Average income is therefore surging far ahead of population growth—human numbers grew ‘only’ 30 percent to over six billion in the same 20-year period.

### ***2) ...while the ecosphere shrinks***

The ecosphere, by contrast, is much diminished. Logging and land conversion to accommodate human demand has shrunk the world’s forests by half and is now proceeding at over 130,000 km<sup>2</sup> per year; similarly, so-called ‘development’ claimed half the world’s wetlands in the 20<sup>th</sup> Century. In all, half the world’s land-mass has already been transformed for human purposes and more than half of the planet’s accessible fresh water is being used by people. Meanwhile, 20 percent of the world’s freshwater fish are extinct, endangered or threatened and 70 per cent of the world’s major fish stocks are being fished at or beyond their sustainable limits. Given the steady erosion of ‘natural’ habitats, it should be no surprise that the rate of biodiversity loss is now 1000 times the ‘background’ rate.

With the ballooning of the economy, some material economic processes have come to rival natural flows and their impacts are global in scope. More atmospheric nitrogen is fixed and injected into terrestrial ecosystems by humans than by all natural terrestrial processes combined; stratospheric ozone depletion now affects both the Southern and Northern Hemispheres; atmospheric carbon-dioxide has increased by 30 per cent in the industrial era and is now higher than at any time in at least the past 160,000 years (or even the past 20 million years). Partially as a result of this last trend, mean global temperature is also a record high and the world is threatened by increasingly variable climate and more frequent and violent extreme weather events (Sources: Lubchenco, 1998; Tuxill, 1998; WRI/UNDP, 2001; Vitousek et al, 1997).

These trends make clear that the exponential expansion of the economy is being accompanied by the accelerating degradation of the ecosphere. This should not come as a surprise—common sense would suggest such a relationship. As shown, however, standard economic models are structurally alien to nature and can neither predict

nor explain the worsening ecological crisis. The best economists can do is to treat the problem as a case of 'market-failure'. They see resource depletion and pollution as unintended 'externalities' (costs not accounted for in market prices). The favoured solution, therefore, is to extend the market process through privatization, proper resource pricing and pollution charges/taxes, with a view toward 'internalizing' environmental costs. Unfortunately, market prices merely reflect current availability, not ecological scarcity, and the whole approach remains incompatible with ecosystems behavior. Because of such 'non-trivial losses of information', commoditizing nature is misleading and potentially dangerous (Rees 1998, Rees and Wackernagel 1999, Vatn and Bromley 1993). Conventional economics is simply no match for the ecological crisis.

### **3) *Human welfare and growing inequity***

It may not be a match for the welfare crisis either. The conventional growth model is not delivering the promised goods even on its own terms. Nor should this come entirely as a surprise. As suggested above, the modern market model eschews moral and ethical considerations; ignores distributive equity; abolishes 'the common good'; and undermines intangible values such as loyalty to person and place, community, self-reliance, and local cultural mores. The negative consequences press particularly hard on developing countries. The latter are being integrated into the global economy through trade and debt-financed export-led 'development'. But the land reforms, the introduction of intensive cropping methods, and the economic 'structural adjustments' (cutbacks in public health, education, and like social programs) required as a condition for the development loan, often have devastating impacts on local environments, subsistence production, and local community integrity.

In these circumstances, economic forces ensure that the benefits of GDP/GWP growth accrue mainly to the already wealthy. Forty-seven nations still have a *per capita* GDP of less than \$855 and are heavily indebted, their governments owing foreigners the equivalent of at least 18 months of export earnings. Many debtor nations are forced to spend more of their income servicing debts to the world's richest nations than providing social services to their own impoverished citizens (Roodman 2001). Chronic poverty thus prevails in the South and the North-South income gap is becoming an unbridgeable gulf. In the late 1950s, the income of the richest 20 percent of the human population, mostly living in the developed North was 30 times that of the poorest 20 percent, most of whom live in the South. By 1989 the ratio had reached 60:1, at which point the richest 20 per cent took home 83 percent of total global income (UNDP 1994), and the ratio is close to 75:1 today. Far from raising all boats, the rising tide is smashing the flimsier craft on the reefs of permanent despair. The expansionist myth is not only wrecking the 'environment', but is also deepening the misery of millions of impoverished people.

Moreover, these trends are increasingly connected. Recent reports show that it is the world's poor—those most directly dependent on local ecosystems for their livelihoods—who suffer the most when ecosystems are degraded or collapse (WRI/UNDP 2001). For example, in 1998 singular events such as Hurricane Mitch and the El Niño weather phenomenon, plus declining soil fertility and deforestation, killed thousands and drove a record 25 million people from the countryside into crowded, under-serviced shanty-towns around the developing world's fast growing cities. This represents 58 per cent of the world's refugees. For the first time, people fleeing violent weather events and ecological decay outnumbered political refugees (IRC 1999). For all such people, achieving sustainable development remains a receding dream.

### **4) *Substitution is no substitute***

The capacity of technology to substitute for the more important functions of nature is increasingly in doubt. In general, substituting manufactured capital for depleted natural capital requires investment that could otherwise be used to build additional (not replacement) productive capital or for consumption. Kaufman (1995) shows that because of the hidden costs of shifting from consumption to investment, "it is not possible to substitute capital for environmental life support and maintain material well-being" (Kaufman 1995). In other words, substituting technology for nature is ultimately a losing proposition.

The rise of net-pen salmon farming in British Columbia illustrates the general problem. Proponents see salmon farming operations as providing a sustainable substitute for the declining wild-fish commercial fishery. However, a recent comparative analysis of commercial salmon fishing methods and net-pen salmon farming by one of my PhD students, Peter Tyedmers, undermines this claim.

Farmed salmon are raised on feed made 15% from slaughterhouse waste, 30% from grain crops, and 56% from rendered fish, including large quantities of anchovy and jack mackerel from Peru and Chile. The production of one metric ton of feed pellets for farmed salmon consumes approximately 48,000 megajoules of energy, including the energy to capture and process other lower-priced fish species. This is the equivalent of 1,300 litres of diesel fuel

equivalent per ton of feed delivered to Campbell River, BC (in the vicinity of several fish farms). The energy required to capture/process/transport just the feed to raise a live-weight kilogram of farmed Atlantic salmon is the equivalent of 2.4 litres of diesel fuel. Farmed chinook are even more energy intensive – about five litres diesel-fuel equivalent is required for feed to raise a kilogram of chinook fillets. This ‘investment’ of money and fossil fuel is not available for other productive purposes (and keep in mind, this is only part of the total energy story).<sup>3</sup>

Peter’s data illustrate at least three other points. First, net pen salmon-farming is similar to terrestrial forms of ‘factory’ livestock raising—indeed, high-input agriculture generally—in that far greater quantities of energy are expended in producing the ‘crop’ than is contained in the marketed product. Declining marginal returns on energy invested is an indicative property of both industrial agriculture and high-input mariculture. Before fossil fuel, farmers and their draught animals must have obtained more from the harvest than they expended in cultivating the crop (otherwise they starved).

Second, only one kg of salmon is produced for every four or five kg of other fish (wet weight) used to produce feed pellets. Much of the southern hemisphere’s wild-fish catch destined for fish meal could be consumed directly by the poor in the exporting countries. Instead it is used to produce a *smaller quantity* of salmon for the rich. In short, salmon farming reduces the total amount of food available for direct human consumption. Surely there is a moral issue hidden in the money-driven global market for farm-raised salmon

The third, and perhaps most important point, is the reminder that costly technological substitutes invariably merely replace a superior free service of nature.<sup>4</sup> When sockeye and pink salmon forage in the North Pacific they capture and concentrate into high quality protein the thinly dispersed energy fixed by marine photosynthesis over a vast and relatively unproductive (compared to inshore waters) region of ocean. It is beyond imagining that a more efficient and equally cost-free harvesting mechanism could ever be developed by humans. (Certainly the fleet of fish-boats scouring the South Pacific catching fish for the rendering [feed] industry doesn’t come close.) Destroying wild salmon stocks through over-fishing or climate change deprives future generations forever of a great free service of nature (and is morally reprehensible in its own right).

## 6 ) *Can we afford free trade?*

According to conventional trade theory (and common understanding), freer trade is to the mutual benefit of all trading partners. Since trade can relieve local shortages (thus seeming to increase local carrying capacity) and catalyze growth, more liberal trade is a mainstay of contemporary globalization. In theory, if each country specializes in those few goods or commodities in which it has a comparative advantage, and trades for everything else, the world should be able to maximize gross material efficiency and total output.

Unfortunately, there is a considerable downside. Globalization creates an increasingly prominent role for transnational corporations; encourages the transportation of resources and manufactured goods all over the planet; facilitates the instantaneous opportunistic movement of finance capital across national boundaries in search of the highest returns and generally encourages the integration of regional and national economies (Korten, 1995). These trends represent a threat to national sovereignty, to accountable democracy, and to economic stability even as they undermine options for community economic development. Meanwhile, corporate agglomeration fosters today’s characteristic trickle-up (or flood) of wealth to the top.

We should also note, that contrary to conventional belief, balanced trade to the mutual benefit of both partners is actually no longer the objective. This is because much of the globally competitive scramble for international markets is actually driven by debt. All firms and countries use trade to import debt-free cash and increase their domestic purchasing power. According to Michael Rowbotham, the blindly compulsive drive ‘to maximize exports, minimize imports and create a trade imbalance... represents a financial struggle between [firms and] nations; a struggle which is entirely the result of the debt-financed financial system and the fact that all nations trade from a position of gross insolvency’ (Rowbotham 1998, p88, emphasis added). In today’s world, each player is attempting to maximize the net inflow of debt-free money by selling abroad. Since trade is a ‘zero-sum-game’ there will be winners and losers – for every net exporter there must be a net importer.

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<sup>3</sup> The fleet fishery also uses fossil fuel, but considerable less per kg of landed salmon than fish farms. The ideal capture method might well be a river-mouth trap fishery that takes returning spawners with little exogenous energy expenditure.

<sup>4</sup> A fourth point might be that if fossil fuel prices were based on a full-social-cost accounting method, we likely couldn’t afford today’s net-pen salmon farms.

As similar enterprises invade each others' markets, the result is a global trading system in which 'goods that could easily be produced locally flow backwards and forwards across the country... and across the whole world' at great ecological and social cost to most trading partners and the world at large (Rowbotham 1998, p89). The intense competition bids down prices, encourages over-production and consumption, accelerates resource depletion, undermines local/regional firms and economies, and eliminates surpluses needed for sound resource management. Meanwhile, the exploding demand for transportation, much of it non-essential, burns up a third of the world's precious oil supplies and contributes to climate change. In short, the rhetorical veil of efficiency through trade actually conceals one of the most wasteful and destructive economic systems imaginable.

### **6) Does continuous growth improve welfare continuously?**

Unwavering commitment to growth in the North would at least be understandable if higher incomes for the already wealthy produced tangible benefits, but this seems not to be the case. World Bank data show that life expectancy and other objective indicators of national population health no longer respond significantly to income growth once it passes a moderate \$7500-\$8000 (international dollars) per person and year. The average *per capita* incomes of the world's wealthiest countries exceed this amount by a factor of three or four yet all are competing for ever more.

Even more surprising, beyond a certain income level there is little indication of improvement in subjective assessments of well-being. Between 1957 and 1993, US real *per capita* income more than doubled to \$16,000. Compared to 1957, "Americans [had] twice as many cars per person—plus microwave ovens, color TVs, air conditioners, answering machines and \$12 billion worth of new brand-name athletic shoes a year" (Meyers and Diener 1995, 13). But were they any happier? Apparently not. In 1957, 35% of respondents told the National Opinion Research Center that they were "very happy". With doubled affluence, 32% said the same in 1993. Certainly to judge by "soaring rates of depression, a quintupled rate of reported violent crime since 1960, a doubled divorce rate, a slight decline in marital happiness among the marital survivors, and a tripled teen suicide rate, Americans are richer, and no happier" (Meyers and Diener 1995, 14). Other studies in the US and elsewhere report similar results.

All of which begs the question: What compels people so adamantly to defend the goal of unlimited income growth when the getting of it apparently sacrifices much of their own value in life, arguably deprives other people of the right to live, and demonstrably threatens the ecological integrity of the planet, all for no measurable benefit whatever?

## ***The Ecological Economics Alternative***

Given its theoretical flaws and growing empirical evidence, ecological economists argue that conventional economic development models are responsible for, or at least aggravate, the sustainability crisis. They have therefore proposed an alternative vision that departs radically from mainstream thinking but arguably better represents reality. (Appendix 1 provides a detailed comparison of these competing economic myths.)

The ecologically-minded see the economy not as a separate isolated system, but rather as an inextricably integrated, completely contained, and wholly dependent subsystem of the ecosphere (Daly 1992) (Figure 2). The first step toward understanding this interpretation is to recognize that despite all our modern gadgetry, human beings remain ecological entities. The biophysical fact of the matter is that through the technology-driven expansion of the economy, human beings have become the dominant consumer organism in most of the world's major ecosystems (i.e., the economy is subsumed by nature). This poses a serious challenge to the mainstream belief that economic activity is not seriously limited by biophysical constraints.

The nested relationship between the ecosphere and the economy is actually typical of complex dynamic self-producing systems. Complex systems theory portrays biophysical systems as Self-Organizing Holarctic Open (SOHO) systems (Kay and Regier 2000). These systems exist in loose, nested hierarchies, each component system contained by the next level up and itself comprising a chain of linked subsystems at lower levels. (Think of the ecosphere as a subsystem of the solar system, individual ecosystems and the economy as subsystems of the ecosphere, individual organisms and people as subsystems of their ecosystems and economies, organ systems as subsystems of the individual, etc., all the way down to organelles as subsystems of individual body cells.)

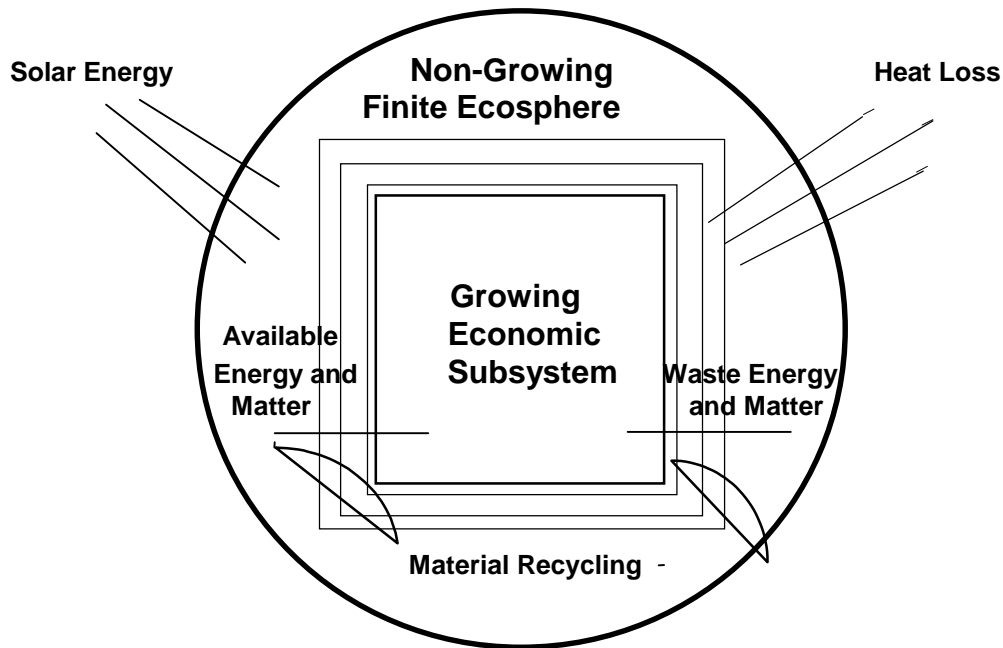
From this perspective, both the economy and the ecosphere are seen as complex self-organizing SOHO systems whose behaviour is ultimately governed not by the simple mechanics of neoliberal analysis but by evolutionary forces, complex systems dynamics and thermodynamic laws. The dynamics of the relationships within the hierarchy containing them is a function of positive and negative feedback loops among and within subsystems. The behaviour of SOHO subsystems is therefore decidedly non-linear, even chaotic.

Most importantly, SOHO subsystems function as ‘dissipative structures.’ Dissipative structures require continuous supplies of available energy, material, and information—various forms of exergy—which they use to produce themselves and to maintain their adaptive self-organizational capacities. SOHO systems also necessarily generate a continuous stream of degraded energy and waste (entropy) that is rejected back into the ‘environment.’ (For example, photosynthesis in the ecosphere dissipates high-intensity solar radiation that is re-radiated into space as low-intensity infra-red radiation; economic production dissipates mainly fossil energy extracted from the ecosphere and injects low-grade heat, water vapor, and carbon dioxide back into the ecosphere.)

All such dissipative processes are inherently thermodynamic in character, so the second law of thermodynamics is central to understanding SOHO dynamics. It follows that the ecologically important flows in the economy are not the circular flows of money but rather the unidirectional and thermodynamically irreversible flows of useful matter and energy from the ecosphere through the economic subsystem and back to the ecosphere in degraded form. This linear throughput is what fuels the economy – despite our technological wizardry, human society remains in a state of obligate dependence on the ecosphere for both the production of useable energy/matter and for waste assimilation (as well as other life support services).

Putting this all together, ecological economics recognizes that the economy is a self-organizing open subsystem within the hierarchy of complex subsystems contained by the ecosphere. Each such SOHO subsystem maintains its internal integrity and grows by dissipating available energy and material imported from its host subsystem one level up in the hierarchy. Subsystems also export their metabolic wastes back into their hosts. In effect, all highly-ordered self-producing systems develop and grow (increase their internal order) “at the expense of increasing disorder at higher levels in the systems hierarchy” (Schneider and Kay 1994).

**FIGURE 2: The Ecological (Steady-State) Perspective**



Ecological economics sees the economy is an open, growing, wholly dependent subsystem of a materially-closed, non-growing, finite, ecosphere.

Several important insights flow from this understanding of economy-ecosphere relationships. First, it is clear that all economic production is *secondary* production. That is, the production and maintenance of our bodies and all economic goods and services is fundamentally a *consumptive* process that uses up a vastly larger quantity of energy

and material first produced by nature. (The thermodynamically productive processes on Earth occur in the ecosphere, not the economy.) The accumulation of economic capital—the goal of capitalist growth—is therefore *necessarily* at the expense of ‘natural capital’ (which conventional economics rarely sees as capital at all). Second, the entire throughput of energy and matter—even the portion initially embodied in useful products—is eventually degraded and injected back into the ecosphere as waste. Third, following from the first two points, the hierarchical relationship between the ecosphere and the economy is potentially pathological. The SOHO model of the economic process structurally embodies the possibility of both resource depletion and pollution should the host-subsystem (ecosphere-economy) relationship become materially imbalanced. In short, the expanding human enterprise is thermodynamically positioned to consume and contaminate—to ‘disorder’—the ecosphere from within.

Clearly sustainability is a more complex problem from the ecological perspective than it appears to be from the economic mainstream. The economy exists in a quasi-parasitic relationship with the ecosphere. It remains dependent on material flows to and from nature and on the reliability of numerous life support services many of which are *invisible* to monetary analyses. Market prices are therefore unreliable indicators of functionally critical ecological scarcity and can have only a limited role in fostering sustainability. Consistent with SOHO hierarchy theory and thermodynamic law, ecological economics therefore eschews material economic growth as the sole solution to ecologically sustainable economic development. Instead, the focus shifts to the promotion of qualitative development.

### ***Seeing the Present in the Past: Humans as Patch-Disturbers***

SOHO systems theory can help us to reinterpret the entire evolutionary history of *Homo sapiens* in a way that reveals the biophysical basis of the sustainability dilemma. However, to support this argument, we first need to understand the basics of human ecology.

I have argued elsewhere that humans are actually a quintessential “patch disturbance” species, a distinction we share with other large mammals (Rees 2000). A patch disturbance species may be defined as *any organism which, usually by central place foraging, degrades a small ‘central place’ greatly and disturbs a much larger area away from the central core to a lesser extent* (definition revised from Logan 1996).

Human patch disturbance is an inevitable consequence of SOHO theory, the second law and two additional realities: first, human beings are big animals with correspondingly large individual energy and material requirements and, second, humans are social beings who live in extended groups. These basic facts of human ecology, together with food productivity data for typical terrestrial ecosystems, suggest *a priori* that in most of the potential habitats on Earth, the energy and material requirements of even small groups of pre-agricultural humans would sooner or later exceed the productive capacity of local ecosystems. Thus, when a group of early human foragers had hunted out and picked over the area in the vicinity of their camp, they would have to move on. Humans are *by nature* nomadic hunters and gatherers who significantly disturb whatever ecosystems and habitats they exploit. To this extent at least, *the potential for pathological unsustainability is encoded in the ancient human genome.*

Despite—or perhaps because of—their great material demands, human beings have evolved uniquely successful strategies to master the full range of earthly ‘environments,’ enabling them to expand both numerically and spatially all over the globe. This ability is attributable to several species-specific qualities of which perhaps three stand out. First, humans have a remarkably variable diet—we have wide-ranging omnivorous tastes and if we cannot consume something directly (such as grass), we domesticate an animal that can and then eat the animal. Second, humans are behaviorally adaptable (e.g., we make and wear clothes) as we are catholic in our diets. Together, these two factors make virtually any terrestrial ecosystem, from grassland and forest to desert and tundra, accessible to *Homo sapiens*. Third, we are creatures of language, culture and cumulative learning. Continuous technological advances have enabled humans continuously to increase the intensity of their exploitation of virtually all the productive habitats on the planet.

It is this last fact that, in modern times, reinforces our shared illusion the human enterprise can grow forever. Reinforced by trade and the great abundance of commodities on world markets, the prevailing myth insists that technology has freed us from biophysical constraints on growth. Arguably, however, technology and more liberal trade have served mainly to accelerate the exploitive depletion of nature’s vast warehouse. We humans and our SOHO economy are steadily increasing our indebtedness to nature.

### **The Cost to Eco-Integrity**

As might be expected, the ecological dominance of humans comes at great cost to other species. When people invade a previously ‘stable’ ecosystem they cannot help but produce significant changes in established energy and material

pathways. There is invariably a reallocation of resources among resident species to the benefit of some and the detriment of others.

It follows that if human appropriations of available energy and materials increase indefinitely, they will cause biodiversity losses and other permanent changes in ecosystem structure and function. Several mechanisms are at work, the effect of which is to increase the impact of human patch disturbance to the global scale (Rees 2000, 2001a). Growing human demand:

5. passively displaces other species from their food niches or appropriates their habitats. (Agriculture pushed bison from the Great Plains of North America; commercial fishing displaces sea lions, seals, and orcas from their preferred food sources; 'clearing' the land for crops and grazing extirpates thousands of species in tropical forests.)
6. actively eliminates non-human competitors—other species that compete with us for 'our' food. (We shoot wolves that hunt ungulates and seals that eat commercially valuable fish; we poison insects that would devour our crops.)
7. depletes both self-producing and non-renewable 'natural capital' stocks. (Humans over-exploit many wild prey populations from rhinos to fish; destroy whole ecosystems such as forests; and deplete vital 'natural capital' stocks, such as ground-water, soils, and fossil fuels.)

The above processes are all consumption-related. The first two are forms of 'competitive exclusion'. Technological 'man' is simply more effective than other organisms at appropriating nature's bounty for his own use. Since flows of available energy and material (exergy) consumed by people are irreversibly unavailable for other species, the latter decline, even to extinction, at least locally.

The third mechanism, stock depletion, is the product of many things, including confidence in technological substitution, blind ignorance, material greed, sheer desperation, and the relentless working of the so-called 'common property problem' on an overcrowded planet. Sometimes it is the result of wilful disregard on the part of those who give no moral standing to other creatures or who simply don't care about the state or fate of the world.

The main point is that when we understand the human economy as a kind of rogue subsystem within the SOHO hierarchy of the ecosphere, we recognize that contrary to popular belief, there is a *fundamental* contradiction between continued material economic growth and the maintenance of bio-integrity. Over-harvesting and habitat destruction are driving what some conservation biologists now refer to as 'the sixth extinction', the greatest extinction episode since the natural catastrophes at the end of the Paleozoic and Mesozoic eras. A quarter of bird species have already been extinguished by people and fully a quarter of the 4400 mammal species living today are on a path of decline which, if not reversed, is also likely to end in extinction. The current rate of species extirpation is 1000 times pre-human levels inferred from the fossil and palaeontological record. This is a remarkably paradoxical record for a species that sees itself as living in splendid isolation from nature.

We should also remember that increased energy and material consumption is necessarily accompanied by equivalent increases in waste production (the other half of the 'second law'). The resultant pollution imposes an additional toll on biodiversity. It hardly needs mentioning that globalization, the sanctioning of greed, the rise of consumerism, and the spread of energy intensive technologies have intensified these dissipative processes. The excessive growth of the economy necessarily increases the entropy of the ecosphere, its ultimate host in the SOHO hierarchy.

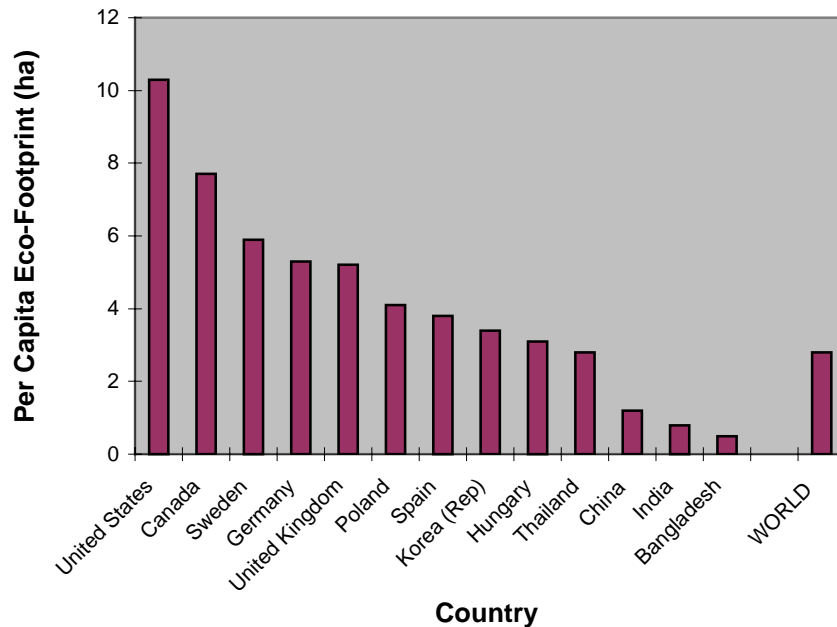
## ***Eco-Footprints, Overshoot and Social Justice***

Whether or not we perceive it in our bones, humans clearly remain an integral—if increasingly disruptive—part of nature. Just how large (and how disruptive) a part we are is revealed by recent 'ecological footprint' studies. Ecological footprint analysis measures the human 'load' on the earth in terms of the area of productive ecosystems required to support the consumptive demands of any defined human population at whatever material standard it enjoys at the time of the assessment (Rees 1996, Wackernagel and Rees 1996). Thus, the ecological footprint of a specified population is defined as the *area of land and water ecosystems required, on a continuous basis, to produce the resources that the population consumes, and to assimilate the wastes that the population produces, wherever on Earth the relevant land/water is located* (Rees 2001a). In effect, ecological footprint analysis estimates of the size of the modern human 'patch.' (It can also serve as an alternative to GDP as a measure of economic scale.)

As might be expected, *per capita* eco-footprints are positively correlated with income. The residents of the United States, Canada, many Western European and other high-income countries each require five to 10 or even 12 hectares (12-30 acres) of productive land/water to support their consumer lifestyles (Wackernagel *et al.* 1999; WWF 2000). By contrast, the citizens of the world's poorest countries have average eco-footprints of less than one hectare.

Even burgeoning China's *per capita* eco-footprint is less than two hectares. The average human ecological footprint is about 2.8 hectares (Figure 3, 1997 data).

**Figure 3: Per Capita Eco-footprints  
of Selected Countries**  
(Data from Wackernagel, *et al.* 1999)

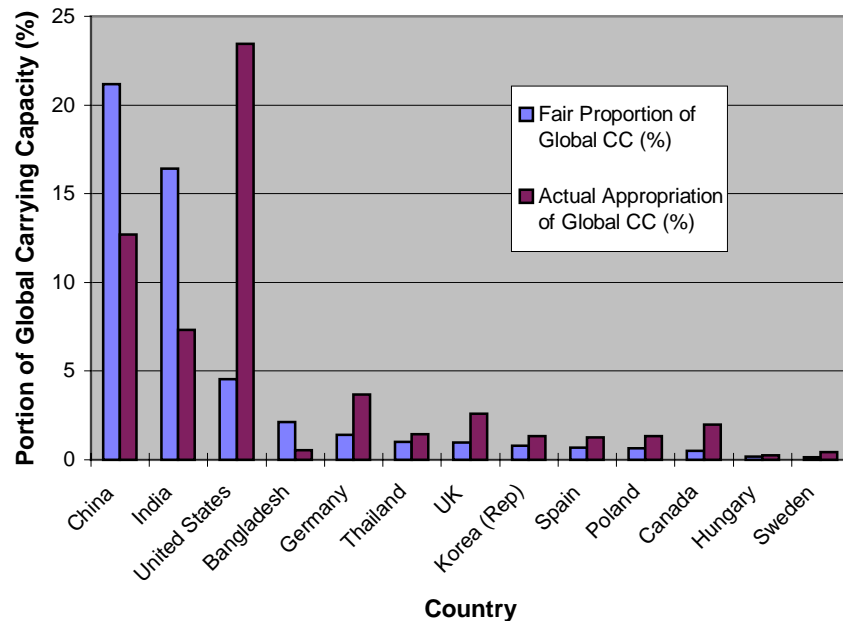


Their large eco-footprints suggest that densely populated high-income countries might require a productive 'patch' larger than their domestic territories. In fact, many such countries have eco-footprints several-fold larger than their domestic land-bases. The citizens of these countries live, in part, on carrying capacity imported from other countries and by imposing on the global commons. In short, the enormous purchasing power of the world's richest nations enables them to finance massive 'ecological deficits' by extending their ecological footprints deeply into exporting nations and throughout the ecosphere (Rees 1996, 2001). Even the apparent productive surpluses of large 'under-populated' countries like Canada have been absorbed by the ecological deficits of other countries.

Ecological footprint analysis thus undermines a major sub-theme of the expansionist myth. Trade (including appropriated natural flows) does not actually increase global carrying capacity—it merely shuffles it around. True, the exchange of factors that would otherwise be limiting, enables each trading region/country to exceed its own local carrying capacity. However, this virtually ensures that all countries, their economies happily expanding through trade, breach the biophysical limits to growth simultaneously (ozone depletion and climate change illustrates the point).

Eco-footprinting also provides new insights into the forces of globalization. First, many high-income countries could not maintain their consumer lifestyles if confined to the biophysical output of their domestic land and water ecosystems. The United States, Europe, Japan and similar countries are dependent on trade and the unsanctioned overuse of common pool life support functions to maintain their economies and to grow. In short, these countries *need* globalization to continue prospering. Second, the same trade and money wealth that enables these rich countries to appropriate so much of the world's economic/ecological output insulate them from the direct negative effects of ecosystems degradation and resource depletion in their own territories. The financial capacity to import carrying capacity effectively short-circuits negative feedback from the land that would otherwise limit local population and economic growth. Globalization thus helps to sustain the illusion among the rich and powerful that the limits to material growth have been permanently abolished and eliminates any reason to question the prevailing expansionist myth.

**Figure 4: Equitable vs. Actual Appropriations of Global Carrying Capacity by Selected Countries**

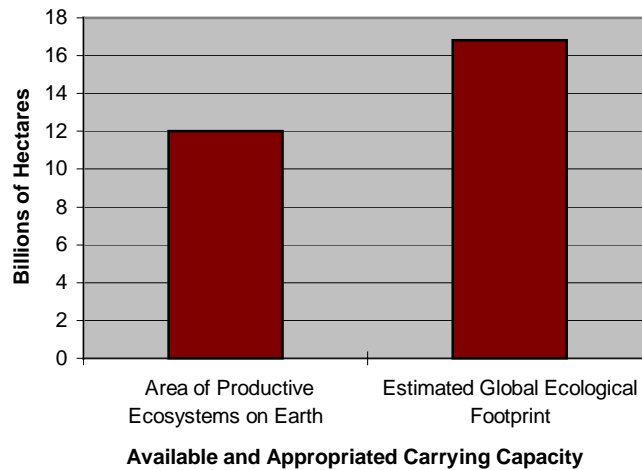


We can highlight the dangers in this situation through international comparison. Figure 4 allocates the biophysical output of the planet to our selection of countries in proportion to their 1977 populations. The figure also shows each country's eco-footprint as a proportion of the earth's total productive land/water area (eco-footprint data from Wackernagel, *et al.* 1999). This comparison reveals that wealthy market economies like those of the US, Canada, most Western European countries and Japan appropriate two to five times their equitable share of the planet's productive land/water (and 20 times or more *per capita* that the chronically impoverished). By contrast, low-income countries like India, Bangladesh and even China, use only a fraction of their equitable population-based allocation. The prevailing forces of globalization tend to exacerbate rather than level these gross economic inequities. As noted, on a finite planet, such trends can lead only to greater geopolitical instability (Gurr 1985, Homer-Dixon and Blitt 1998, Homer-Dixon *et al.* 1993, )

The possibility of greater scarcity-induced international tension begs the question: just how close are we to global ecological limits? Eco-footprinting enables such an estimate. There are only about nine billion hectares of productive cropland, pasture, and forest on Earth and perhaps three billion hectares of equivalent shallow ocean, for a total of 12 billion productive hectares (two hectares *per capita*). However, with an estimated average eco-footprint of 2.8 ha *per capita*, the present human population already has a total eco-footprint of almost 17 billion hectares.

These data suggest we have already 'overshot' the long-term human carrying capacity of the Earth by as much as 40% (Figure 5). If this seems impossible, remember that a population can live in overshoot—i.e., beyond its ecological means—for a limited period by depleting vital ecosystems and drawing down non-renewable resource stocks. Anyone needing proof of this liquidation hypothesis need only refer to daily newspaper reports on ozone depletion, climate change, deforestation, fisheries collapses, biodiversity loss, etc. More concretely, The Worldwide Fund for Nature recently reported that its 'living planet index' is declining in proportion to the increase in humanity's eco-footprint (WWF 2000).

**Figure 5: Over-Shooting Carrying Capacity**



Of course, capital liquidation permanently reduces future carrying capacity—extinction/depletion is forever. Julian Simon’s assertion that we have the technology “... to feed, clothe, and supply energy to an ever-growing population for the next seven billion years” may well be sorely tested in just the next 50 years! In fact, it is doubtful that we can safely sustain even current gross production/consumption levels for the next few decades using known technologies. Managing the anticipated five- to eight-fold increase in industrial activity expected over the next half-century is another matter altogether. (We would need the equivalent of four Earth-like planets to support just the present human population of 6 billion sustainably at Canadian levels of material consumption.)

### ***Where Do We Go from Here?***

The prevailing expansionist development myth assumes that the road to global sustainability will be paved with sheer economic growth. Any ecological problems along the way will be solved through the marketplace and human technological ingenuity. By contrast, the ecological perspective posits that the major potholes in the road are *caused* by uncontrolled growth and burgeoning global trade. Indeed, eco-footprinting and similar biophysical analyses suggest that, at this stage in global development, further material growth threatens to impose an impassable barrier to sustainability.

If this conclusion is correct then the ‘sustainability crisis’ is not merely a technical nor economic problem as usually conceived, but rather a problem of human ecological dysfunction (Rees 2000) exacerbated by a maladaptive cultural myth. Those who would work toward ecologically sustainable socioeconomic development must first confront this reality. We are at a turning point in human history where biophysical constraints are forcing a shift from ‘empty-world’ to ‘full-world’ economic thinking (Daly 1991b, Goodland 1991).

More-than-full-world thinking, actually. The scientific evidence suggests that if we are serious about ensuring the long-term integrity of the ecosphere and sustaining human civilization, an absolute reduction (by as much as 50%) in the total dissipative load imposed on ecosystems by people may be required (Carley and Spapens 1999). Human economic activities cannot for long consume more resources than nature produces nor produce more wastes than nature can assimilate.

People have not previously been confronted with the possibility that they might actually have to *reduce* consumption (or at least their use of energy and materials). The problem becomes particularly acute when we recognize that the great majority of humankind is understandably not satisfied with its present material lot and is determined to improve it. Indeed, income growth in the Third World is necessary to meet even basic physical requirements and therefore morally justified. In these circumstances, improved living standards for the impoverished can be accommodated only if the rich are willing to share more of the existing eco-economic pie. To create the ‘ecological space’ for expansion in developing countries the already wealthy must reduce their ecological footprints.

Is there any realistic hope that the required shrinkage and redistribution can be achieved when the mythos of Western industrial culture and the logic of expansionist economics encourage individuals and nations alike to behave as self-interested utility maximizers? (The inevitable result of everyone trying to maximize his/her use of resources

on a finite planet is the competitive over-exploitation of common-pool resources [Ophuls and Boyan 1992, Ch.4]). Are there any circumstances short of imminent (and evident) global collapse in which the presently rich would be willing to consider any significant reduction in their own material prospects that the poor might live at all?<sup>5</sup> The challenge is both clear and daunting. As Lynton Caldwell (1990, 173) observes:

The prospect of worldwide cooperation to forestall a disaster... seems far less likely where deeply entrenched economic and political interests are involved. Many contemporary values, attitudes, and institutions militate against international altruism. As widely interpreted today, human rights, economic interests, and national sovereignty would be factors in opposition. The cooperative task would require behavior that humans find most difficult: collective self-discipline in a common effort.

Humanity is clearly in the position of having to prove its claim to being an intelligent, rational and self-aware species. In the face of the evidence, the unthinking continuation of today's unsustainable practices would be an act of colossal collective stupidity. We must therefore recognize that we are being driven by genetically influenced individual and social behaviours reinforced by a cultural myth of our own making. Most importantly, we must find the political will in the international arena to override these now maladaptive tendencies. Success in this challenge would mark the next step in human evolution and clearly elevate human consciousness above that of other organisms.

Should we get past this behavioural barrier, we would have to develop a multi-faceted approach to the sustainability problem itself. (As we have shown, the marketplace alone is certainly no guide to sustainability.) Future global development planning must include explicit policies to:

1. lower human populations everywhere;
2. reduce material consumption in the high-income countries through more efficient technologies;<sup>6</sup>
3. encourage the adoption of simpler, less materially intensive lifestyles in the high-income countries, and
4. provide the developing world with the best available technologies to limit the impacts of essential growth.

At present—and unfortunately for sustainability and the long-term human prospect—discussion of the first objective is suppressed (one is likely to be labeled racist); most politicians (particularly in North America) dismiss the second and third objectives as politically naïve or unfeasible (“...the American life-style is not up for negotiation”); and prevailing market morality and the rise of intellectual property rights prohibit the fourth. It seems that the human evolutionary path does not yet converge with sustainability.

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<sup>5</sup> Ironically, one of the effects of global restructuring under the expansionist paradigm has been a marked increase in income disparity in many countries, including the U.S. (see *The Economist* November 5th-11th, 1994 for several articles on “slicing the cake”).

<sup>6</sup> Increased resource productivity (technological efficiency) is sometimes evoked as a sufficient means both to increase production and reduce demand without affecting quality of life. This approach has intrinsic appeal. However, the historic evidence suggests that without an accompanying shift in fundamental values, efficiency gains tend to lower prices and raise wages/salaries. With more money chasing cheaper goods and services, the effect is an increase in gross consumption.

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