Globalization and Sustainability: Conflict or Convergence?

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Unsustainability is an old problem - human societies have collapsed with disturbing regularity throughout history. I argue that a genetic predisposition for unsustainability is encoded in certain human physiological, social and behavioral traits that once conferred survival value but are now maladaptive. A uniquely human capacity - indeed, necessity - for elaborate cultural myth-making reinforces these negative biological tendencies. Our contemporary, increasingly global myth, promotes a vision of world development centered on unlimited economic expansion fuelled by more liberalized trade. This myth is not only failing on its own terms but places humanity on a collision course with biophysical reality - our ecological footprint already exceeds the human carrying capacity of Earth. Sustainability requires that we acknowledge the primitive origins of human ecological dysfunction and seize conscious control of our collective destiny. The final triumph of enlightened reason and mutual compassion over scripted determinism would herald a whole new phase in human evolution.

Fundamentals of (Un)Sustainability: The Easter Island Syndrome

> In just a few centuries, the people of Easter Island wiped out their forests, drove their plants and animals to extinction, and saw their complex society spiral into chaos and cannibalism. Are we about to follow their lead? (Diamond, 1995)

(Un)sustainability is an old problem. Easter Island is just one example of the collapse of an entire society unable to cope with changing circumstances, perhaps made more poignant by its having occurred in relatively recent times. A mere handful of Polynesian wanderers first populated the then lushly forested island only in the 5th century. The new colony developed and flourished over the next thousand years, acquiring a complex social structure, division of labor, religion, art, and science. The human population of Easter Island peaked at perhaps 7,000 to 10,000 in about 1500 (although some estimates range up to 20,000; Diamond, 1995). By this time, the island's forests had been destroyed by overharvesting, seed "predation" by introduced rats, and the loss of pollinating birds. Consequently, the people were no longer able to build the large canoes essential to maintaining their diet of porpoise and fish. Shellfish, nesting seabirds (many of which were wiped out), and domestic chickens proved an inadequate substitute, and the human population began a steep decline. It had collapsed to about 2,000 wretched individuals by the time the island was "discovered" by the Dutch admiral Roggeveen on Easter Sunday in 1722. Roggeveen found the sorry remnants of Easter Island society living in rude reed huts and caves, eking out a sparse existence from a denuded landscape and cannibalistic raids on each other's camps.

The obvious question is, how could the Easter Islanders have allowed this spectacular rise and fall in their collective fortunes to unfold unchecked? Was it not self-evident that resource depletion in such an obviously finite habitat would lead to disaster? After all, the people of the island must have been aware "that they were almost completely isolated from the rest of the world, must surely have realized that their very existence depended on the limited resources of a small island. . . . Yet they were unable to devise a system that allowed them to find the right balance with their environment" (Ponting, 1991, p. 7).

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As noted, Easter Island set no precedents. Even those used to assuming that continuous technological progress is the norm, and that modern society has forever banished Malthus's ghost, might be taken aback to learn that collapse seems to be an inevitable stage in the development of human societies. Indeed, "what is perhaps most intriguing in the evolution of human societies is the regularity with which the pattern of increasing complexity is interrupted by collapse" (Tainter, 1995, p. 399). In his most comprehensive treatment of this great enigma, Tainter (1988) reviewed two dozen examples of this cycle, and dozens more undoubtedly go unremarked by the historical record.

The purpose of this article is to assess the state and possible fates of modern industrial society in light of human evolutionary and sociocultural history. Are we indeed about to "follow the lead" of Easter Island?

This question may seem preposterous to the modern mind. Technological optimists and many others living today believe that modern society has transcended nature, that, sustained by human ingenuity, it is inherently sustainable. From this perspective, "the rich historical record of societies that have collapsed represents . . . not the normal destiny of complex societies, but a set of anomalies needing to be explained" (Tainter, 1995, p. 398).

By contrast, my working hypothesis is that the pattern set by Tainter's cases and the implosion of Easter Island is, in fact, the norm. Indeed, the future is potentially more problematic for technological "man" than for any preceding culture. I argue below that "unsustainability" is an *emergent property* of the systemic interaction between technoindustrial society and the ecosphere. In short, the structure and behavior of the modern human system are fundamentally incompatible with the structure and behavior of critical ecosystems. No realignment of the present set of interacting components and relationships can be sustainable without a fundamental change in critical sociocultural variables determining those relationships.

In addition, I argue that the seeds of human ecological and social unsustainability spring from the very nature(s) of *Homo sapiens*. That is, a genetic predisposition for unsustainability is encoded in human physiology, social organization, and behavioral ecology. The historical record represents the phenotype of this fundamental flaw; modern technological prowess as manifested in globalization merely spreads the damage and increases the risk to everyone.

The situation is not entirely bleak. We can draw some optimism from the fact that human evolution is at least as much determined by sociocultural factors as by biological factors. The bad news here is that, like maladaptive biological mutations, cultural variations are also subject to natural selection. The unbroken history of societal collapses is graphic proof that maladaptive cultural traits and even whole cultures can be "selected out." The good news is that modern society has a major advantage over its predecessors. We are uniquely positioned to understand the forces of biocultural determinism that have heretofore had the quality of inevitability. In theory, this gives us the power at last to seize control over our own destiny and end the cycle of cultural boom and bust.

Exploring the Roots of Collapse

Many determinants or drivers contribute to human societal collapse. In this article, I highlight only two. The first can be summarized as the uniquely human capacity—indeed, necessity—for elaborate myth-making. All human cultures develop unique "stories" that serve to explain their existence and to make sense of the world as they see it. The second factor is the human tendency toward extreme "patch disturbance." It is a fact of human bioenergetics and social behavior that we necessarily significantly perturb any habitat or ecosystem of which we are a part. I contend that this fundamental fact of human ecology, reinforced by a particularly pernicious modern cultural myth, makes of modern humans the most ecologically destructive and potentially self-destructive culture ever to inhabit the planet. The question for sustainability is this: Will modern humans, both the perpetrators and potential victims of their own destructive tendencies, be able to look themselves in the eye and wrest their future from the tyranny of biocultural determinism that marks their evolutionary history?

The Central Role of Myth

One of the most ironically enduring myths of industrial society is that modern nations, products of the enlightenment all, are no longer the dupes and slaves of myth. True, the industrial era is the age of science, but this has not prevented us from being as myth-bound as any culture that has preceded us. The modern mind has difficulty grasping this paradox only because we have learned to equate myth with falsehood, super-

stition, and the unscientific beliefs of "primitive" peoples. But this belies a shallow and sterile dismissive view of myth—myth-making is a universal property of human societies and plays a vital role in every culture.

It is easy to imagine how this form of social behavior might evolve if it provided even marginal selective advantage to people with a tendency to mythologize. For example, early humans would benefit greatly from the social cohesion and tribal identity that would accrue from developing sharing cultural stories. Indeed, it seems that mythic representations of reality gradually became essential social glue. They helped explain the wild and mysterious in nature and therefore made sense of the world to the emerging intelligence of humankind. In this light, consider Grant's (1998) enlightened perception of myths "not as mistaken views but as comprehensive visions that give shape and direction to life" (p. 1). Seen this way, myths "move from being dispensable misunderstandings to essential categories that we all take for granted" (p. 1). At bottom, of course, all our great cultural stories—our myths—are ungainly concoctions of fact, belief, and shared illusion shaped and polished by frequent repetition and ritualistic affirmation.

While cultural myth-making is both necessary and generally benign, there is also a darker side in which our shared illusions amount to little more than deep denial in the service of nefarious ends. (Remember the Holocaust?) As Jensen (2000) observed, "For us to maintain our way of living, we must . . . tell lies to each other, and especially to ourselves. . . . The lies act as barriers to truth. The barriers . . . are necessary because without them many deplorable acts would become impossibilities" (p. 2).

A Modern Myth: Sustainability Through Growth

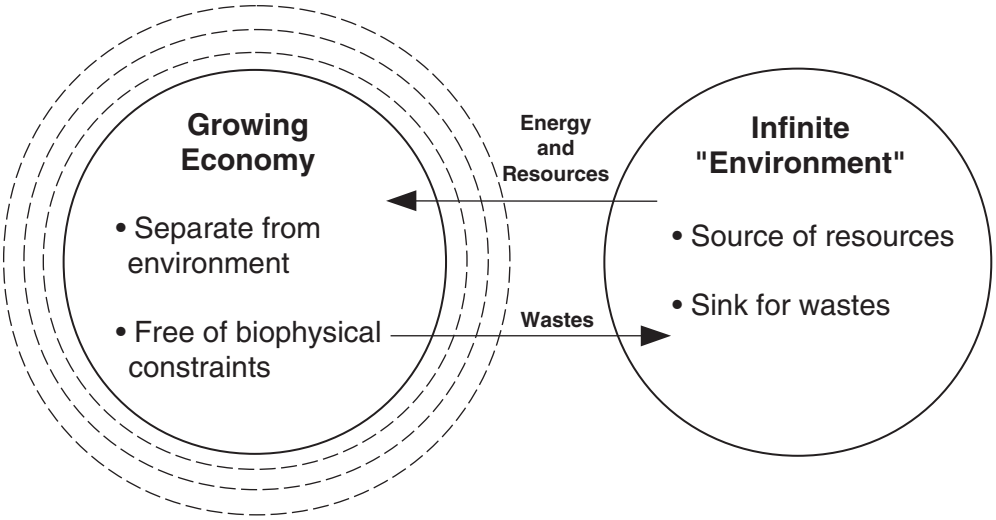
Contemporary history illustrates just how ready humanity is to delude itself in the face of contrary evidence. In recent years, the governing elites of the market democracies have persuaded or cajoled virtually the entire world to adopt a common myth of uncommon power. All major national governments and mainstream international agencies are united in a vision of global development and poverty alleviation centered on unlimited economic expansion fueled by open markets and more liberalized trade.

At the heart of this expansionist vision (the "dominant economic paradigm") is the belief that human welfare can all but be 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 late 1970s. For the first time, the world seems to be converging on a common development ideology, one that promises ever-increasing wealth for everyone, everywhere.

Like all abstractions, the global market model/myth 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 (Daly and Cobb, 1989) (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.

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 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. Indeed, they argue 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; United Nations World Commission on Economy and Environment, 1987).

But is sustainable development really this easy, we merely have to stick with the status quo? The following section examines 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 does the real world tell us? And finally, what might an alternative development framework based on material human ecology look like?



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).

Figure 1. The Expansionist Perspective

Dissecting Expansionism[1]

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 United Nations' groundbreaking World Commission on Environment and the Economy (1987) (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, although 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" (p. 213).[2]

Prevailing economic rationality relies heavily on the assumed simple mechanics of free and open markets to ensure sustainability. 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 original resource and stimulate the search for technological substitutes. The late professor Julian Simon was perhaps the most ebullient proponent of what has become the near doctrine of "near-perfect substitution": "Technology exists now to produce in virtually inexhaustible quantities just about all the products made by nature . . . 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" (quoted in Bartlett, 1996, p. 342). 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 nonrenewable 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 & Morse, 1963), although a leveling of this trend may have occurred around 1970 (Nordhaus, 1992). Because 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, p. 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 (for a full exposition, see Beckerman, 1974). In short, mainstream thinking holds that "the surest way to improve your environment is to become rich" (Beckerman, 1992, p. 491, as cited in Ekins, 1993, p. 276).

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 here 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 the practice of conventional economics. Their critique is concrete and comprehensive. Some examples follow.

The Fallacy of Misplaced Concreteness

Those living a myth are the least likely to see it for what it is. As McMurtry (1998) observed,

> [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. . . . 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." (p. 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*, it "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, pp. 22-23). This is why Saul (1995) can argue that "we have all by our actions or lack of them—particular over the last quarter-century—agreed to deny reality" (p. 18).

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 neighborhoods, 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 (e.g., through taxation or other means of income redistribution) would actually be sound economics—it would increase net social welfare (Heuting, 1996).

The real tragedy is 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 the global commons or some unmeasured form of social capital 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.

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, 1991, p. 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, and so on (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, 1991, p. 196). The most fundamental neoliberal model therefore cannot represent the materials, energy sources, physical structures, and time-dependent processes that are basic to understanding ecosystem 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 ecosystems, the systems with which the economy interacts in the real world.

. . . 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 behavior, 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, 1994/1997). Theoretically, a free-market competitive equilibrium is optimally efficient—that is, demand equals supply in every market (markets clear) and all resources are fully used. 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 stinted theoretical ideal depends on the following critical assumptions:

> Diminishing marginal returns in consumption and production.
> Perfect competition among a hyperinfinite continuum of traders (buyers and sellers), none of whom can individually influence prices
> All traders having perfect knowledge of all present and future markets
> An infinite number of future markets

None of these necessary conditions obtain in the real world. Ormerod (1994/1997) concluded 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" (p. 66).

And The Problems Run Much Deeper (and Wider)

Galbraith (2000, p. 1) made a similar but more general point in his critique of the 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 took this "disconnect" from the real world as evidence that "modern economics . . . seems to be, mainly, about *itself*." He continued,

> 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. (p. 4)

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 fares the ecosphere?

The Economy Balloons . . .

First, the (qualified) good news. There can be little doubt that globalization and freer trade have been a strong stimulus to production growth and gross world product. The global economy has expanded fivefold in the past half-century, threefold since 1980 alone. Average income is therefore surging far ahead of population growth—human numbers grew "only" 30% to more than 6 billion in the same 20-year period.

. . . 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 more than 130,000 km^2 per year; similarly, so-called development claimed half the world's wetlands in the 20th 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% of the world's freshwater fish are extinct, endangered, or threatened and 70% 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 1,000 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% 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 at a record high and the world is threatened by increasingly variable climate and more frequent and violent extreme weather events (Lubchenco, 1998; Tuxill, 1998; Vitousek, Mooney, Lubchenco, & Melillo, 1997; World Resources Institute/United Nations Development Program, 2000).

These trends make it 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 that 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 favored 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 & Wackernagel, 1999; Vatn & Bromley, 1993). Conventional economics is simply no match for the ecological crisis.

Human Welfare and Growing Inequity

It may not be a match for the welfare crisis either. The conventional growth model is not adequately 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 other such social programs) required as a condition for the development loan often have devastating impacts on local environ-

ments, 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 rather than providing social services to their own impoverished citizens (Roodman, 2001).

Chronic poverty thus prevails in much of the southern hemisphere, and the income gap between high-income Organization for Economic and Cultural Development (OECD) countries and the southern hemisphere is growing. The absolute gap is widening everywhere, and even the relative income gap is increasing for most regions. (East Asia is the major exception—per capita incomes have gone from one tenth to almost one fifth of those in the high-income OECD countries since 1960.) In 1970, the richest 10% of the world's citizens earned 19 times as much as the poorest 10%. By 1997, the ratio had increased to 27:1. At that time, the wealthiest 1% of the world's people commanded the same income as the poorest 57%, and 25 million rich Americans (.4% of the world's people) had a combined income greater than that of the poorest 2 billion of the world's people (43% of the total population). (Income ratios reflect purchasing power parity. Data are from the United Nations Development Program, 2001.) Far from raising all boats, the rising economic tide is stranding the flimsier craft on the reefs of 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 (World Resources Institute/ United Nations Development Program, 2000). 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, underserviced shantytowns around the developing world's fast-growing cities. This represents 58% of the world's refugees. For the first time, people fleeing violent weather events and ecological decay outnumbered political refugees (International Red Cross, 1999). For all such people, achieving sustainable development remains a receding dream.

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) showed 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" (p. 77). In other words, substituting technology for nature is ultimately a losing proposition.

This problem can be illustrated using the example of high-tech heated hydroponic greenhouses operating in the Lower Mainland of British Columbia, Canada. These industrial "farming" operations are so seemingly productive that proponents sometimes suggest that we no longer need to preserve traditional cropland. This is a dangerously premature conclusion. Wada (1993) prepared a detailed comparison of the land area and energy/material throughputs required to grow a thousand tons of tomatoes in hydroponic greenhouses compared to the corresponding requirements of high-input traditional agriculture. He found that the greenhouses were, in fact, six to nine times as productive per unit growing area as was traditional field culture (Figure 2a). However, when all energy and material flows were taken into account, the "ecological footprint" of a greenhouse tomato was 14 to 20 times as large as that of a high-input field farm tomato (Figure 2b).[3]

Wada's (1993) analysis reveals the fundamental unsustainability of heated hydroponic greenhouses. As might be predicted from the second law of thermodynamics, the seemingly higher output was "financed" by the dissipation of large quantities of depletable energy and resources, particularly natural gas and fertilizer (the latter also made partially from natural gas). High-tech agriculture substitutes nonrenewable materials for renewable sun and soil. It therefore increases human dependence on unreliable technology, diverts financial and natural capital from other productive uses, and contributes to atmospheric greenhouse forcing. Moreover, when natural gas prices rose steeply in the late 1990s, the many green-

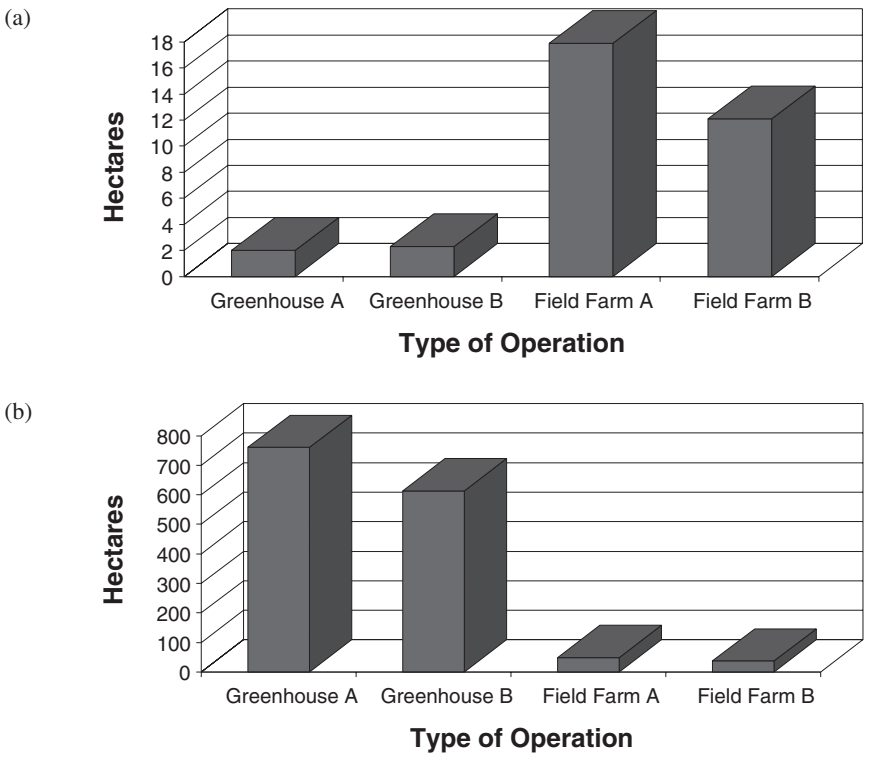


Figure 2. (a) Area Required to Grow 1,000 Tons of Tomatoes/Year and (b) Calculated Ecological Footprint (Area "Appropriated" to Grow 1,000 Tons of Tomatoes/Year)

house operations were pushed to the edge of bankruptcy. Some saved themselves by shifting to less expensive—and even less sustainable—fuel oil.

Can We Afford Free Trade?

According to conventional trade theory (and common understanding), freer trade is to the mutual benefit of all trading partners. Because 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 therefore total output.

Unfortunately, there is a significant 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. Trade in these conditions also accelerates natural capital depletion. Meanwhile, corporate agglomeration and other advantages accruing to capital accumulation foster today's characteristic trickle-up (or flood) of wealth to the top.

One should also note that contrary to conventional belief, balanced trade to the mutual benefit of both partners is no longer the objective. This is because much of the globally competitive scramble for international markets is actually driven by national and corporate debt, the servicing of which greatly reduces internal purchasing power.[4] All nations are thus engaged in a blindly compulsive drive "to maximize exports, minimize imports and *create a trade imbalance*" in order to increase the amount of debt-free money in domestic circulation. By this interpretation, trade 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, p. 88; emphasis added).

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, p. 89). The intense competition bids down prices, encourages overproduction and consumption, undermines local/regional firms and economies, and eliminates surpluses needed for sound resource management. Meanwhile, the exploding demand for transportation, much of it nonessential, burns up one third of the world's precious oil supplies and contributes to climate change. In short, the rhetorical veil of efficiency actually conceals one of the most wasteful and destructive economic systems imaginable.

There are other problems particularly affecting developing nations. Economist J. W. Smith (2000) reminds us that the major international institutions leading the globalization charge in the developing world were actually never intended to be development institutions. Indeed, the fundamental goal of creating markets for industrialized countries was written into their charter. Accordingly, the structural adjustment programs imposed by the International Monetary Fund and the World Bank as a condition for development loans force borrowing countries to lower their standards of living and to export more minerals, timber, and food both to pay down their loans and to purchase imports from high-income countries.

However, in the increasingly open global marketplace, developing countries must compete with each other for first-world markets. This bids down the prices for developing countries' commodity exports in relation to the prices of the manufactured goods and services they must import. Between 1980 and 1993, prices for primary commodities fell by more than 50% relative to prices for manufactured goods. By the early 1990s, the annual loss to developing countries was estimated at $100 billion, more than twice the total aid flow in 1990 (Gorringe, 1999).

In short, current terms of trade create a relative price difference that is "even more effective than colonialism in appropriating the natural wealth and labors of the undeveloped countries" (Smith, 2000). Remarkably, although developed countries claim to be financing the developing countries, the poor countries are actually financing the rich through low pay for equally productive labor, investment in commodity production for the wealthy world, and other dimensions of unequal trade. Little wonder urban poverty is on the rise and third-world cities are foundering.

Most significantly, Smith (2000) observed that the terms of trade and of the structural adjustment programs forced upon Third World countries are exactly opposite to the policies under which the wealthy nations developed. This tells us that the power brokers of the developed countries know exactly what they are doing: Their grand strategy is to impose unequal trades upon the world so as to lay claim to the natural wealth and the labors of the weak nations (Smith, 2000). The strategy is clearly effective: In the 1960s, "only" three dollars flowed to the northern hemisphere for every dollar flowing to the southern hemisphere; by the late 1990s, the ratio was seven to one (Smith, 2000).

Does Continuous Growth Improve Welfare Continuously?

Unwavering commitment to growth in the northern hemisphere 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 $7,500 to $8,000 (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 even 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, U.S. 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" (Myers & Diener, 1995, p. 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" (Myers & Diener, 1995, p. 14). Other studies in the United States and elsewhere report

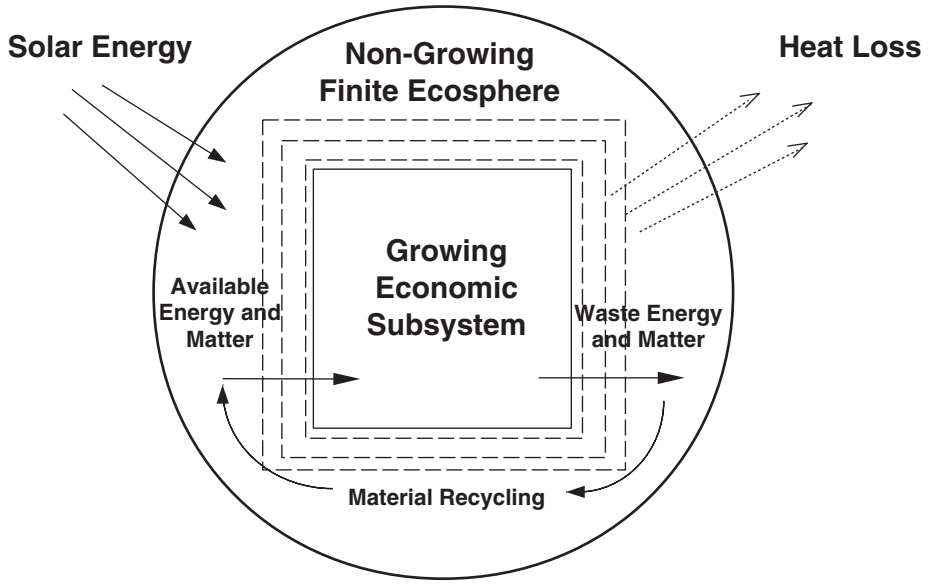


Figure 3. The Ecological (Steady-State) Perspective

similar results (for a comprehensive review, see Lane, 2000).

What does seem to affect felt well-being in the developed world is *relative* income. Among high-income countries, it is not the richest societies that have the best individual and population health but rather those with the smallest income differences between rich and poor (Wilkinson, 1996). Another important factor is a sense of control over decisions affecting daily life. Frey and Stutzer (2002) found that the greater the degree of local autonomy and the more developed the local democratic institutions, the more satisfied people are with their lives. The availability of institutions that facilitate individual involvement in politics increases happiness more than does rising income. Ironically, growing inequity and greater alienation of people from decision processes affecting their lives are major trends accompanying globalization.

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 what they themselves 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 whatsoever?

The Ecological Economics Alternative[5]

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.

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 3). The first step toward understanding this interpretation is to recognize that despite all our modern gadgetry, human beings remain ecological entities. The biophysical fact 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 por-

trays biophysical systems as self-organizing holarctic open (SOHO) systems (Kay & 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, and so on, 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 SOHO systems whose behavior 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 behavior of SOHO subsystems is therefore decidedly nonlinear, even chaotic.

Most important, SOHO subsystems function as "dissipative structures." Dissipative structures require continuous supplies of available energy, material, and information—various forms of essergy—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 reradiated into space as low-intensity infrared 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—technology notwithstanding, human society remains in a state of obligate dependence on the ecosphere both as a source of usable energy/matter and as a sink for waste.

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 system's hierarchy" (Schneider & Kay, 1994).

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 thermo-

dynamic 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.

Patch Disturbance: A Harbinger of Unsustainability?

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 that, 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 system 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 preagricultural humans would sooner or later exceed the productive capacity of local ecosystems. Humans are, by nature, nomadic hunters and gatherers who significantly disturb whatever ecosystems and habitats they exploit. In effect, the potential for pathological unsustainability under conditions of continuous growth is foreshadowed in the basic ecology and social behavior and of *Homo sapiens*. It 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 as 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 that 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 Maximum Power Principle and Competitive Exclusion

Boltzmann (1905) recognized that the [Darwinian] struggle for life is a struggle for free energy available for work. The reason is simple—energy is a critical factor in the structure and function of all living systems. Evolutionary success can therefore be interpreted as an example of the maximum power principle: Systems that prevail [i.e., successful systems] are systems that evolve to maximize their use of the energy [and material] resources available to them (Lotka, 1922). Humanity's dominance of the ecosphere is the result of our competitive superiority at appropriating the energy flows and material resources of the ecosphere.

Because photosynthetic energy flows through natural ecosystems are essentially fixed, the ecological dominance of humans comes at great cost to other consumer species. When people invade a previously "stable" ecosystem, they cannot help but to 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). Growing human demand (a) 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; and "clearing" the land for crops and grazing extirpates thousands of species in tropical forests), (b) actively eliminates nonhuman competitors—other species that compete with us for "our" food (e.g., we shoot wolves that hunt either wild ungulates [deer or moose] or domestic livestock, and seals that eat commercially valuable fish; we poison insects that would devour our crops), and (c) depletes both self-producing and nonrenewable "natural capital" stocks (humans overexploit many wild prey populations from rhinos to fish, destroy whole ecosystems such as forests, and deplete vital "natural capital" stocks, such as groundwater, 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. Because flows of available energy and material 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 willful disregard on the part of those who give no moral standing to other creatures or who simply do not 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 biointegrity. Overharvesting 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 periods. This is a remarkably paradoxical achievement for a species that sees itself as living in splendid isolation from nature.

One 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.

Our Ecological Footprint: Overshooting Human Carrying Capacity

SOHO systems dynamics make clear that humans 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 & 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, 2001b). In effect, ecological footprint analysis estimates the size of the modern human "patch."[6]

As might be expected, per capita ecofootprints are positively correlated with income. The residents of the United States, Canada, and many Western European and other high-income countries each require 5 to 10 or even 12 hectares (12 to 30 acres) of productive land/water to support their consumer lifestyles (Wackernagel et al., 1999; Worldwide Fund for Nature, 2000). By contrast, the citizens of the world's poorest countries have average ecofootprints of less than 1 hectare. Even burgeoning China's per capita ecofootprint is less than 2 hectares. The average human ecological footprint is about 2.8 hectares (Figure 4).

Consider these demand data in light of global supply. There are only about 9 billion hectares of productive cropland, pasture, and forest on earth and perhaps

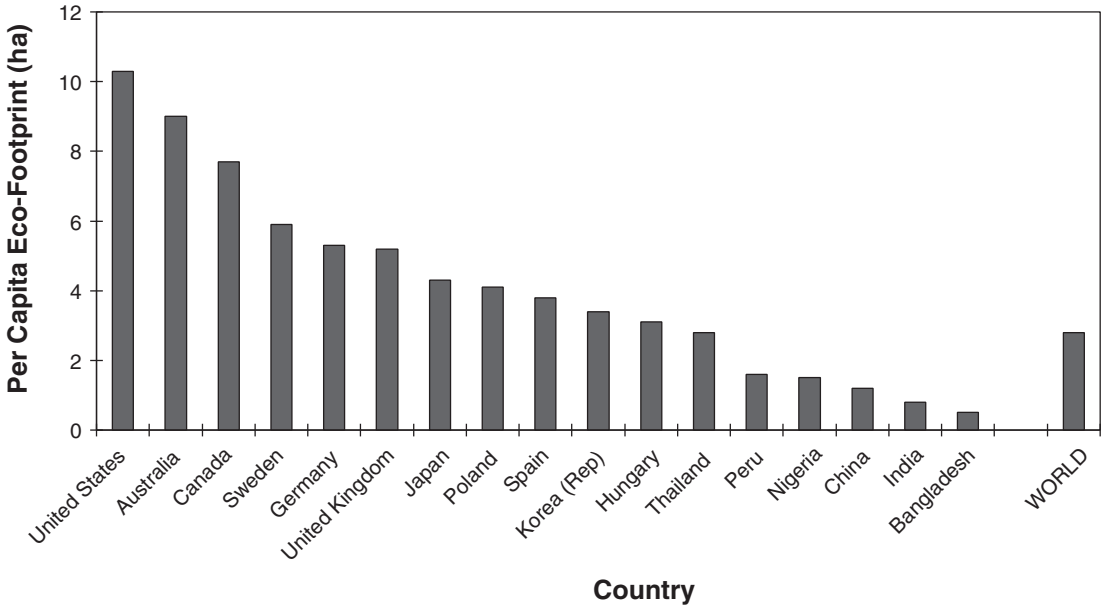


Figure 4. Per Capita Ecofootprints of Selected Countries (1997 Data)
Based on data from Wackernagel et al. (1999).

3 billion hectares of equivalent shallow ocean, for a total of 12 billion hectares. In short, there are only 2 hectares of productive ecosystem per capita on the entire planet. With an estimated average ecofootprint of 2.8 hectares per capita, the present human population already has a total ecofootprint of almost 17 billion hectares. This means that humanity has already "overshot" the long-term human carrying capacity of the earth by up to 40%. (A population can live in overshoot [i.e., beyond its ecological means] for a considerable period by depleting vital ecosystems and nonrenewable resource stocks.) It also means that to bring just the present world population up to, say, Canadian material standards with prevailing technology would require three additional Earth-like planets.

The situation is even more complex than such gross overshoot would suggest. Many high-density, high-income countries have ecofootprints several-fold larger than their domestic territories. These countries are running large "ecological deficits" with the rest of the world. Their citizens live, in part, on life support services imported from other countries and by imposing a disproportionate load on the global commons.

Indeed, wealthy market economies such as those of the United States, 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 than the chronically impoverished). By contrast, low-income countries such as 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 ecoeconomic inequities.

Ecofootprinting thus reveals the hidden (thermodynamic) role of global trade. The enormous purchasing power of the world's richest nations enables them to finance their ecological deficits by extending their ecological footprints deeply into exporting nations and throughout the open ecosphere (Rees, 1996, 2001b). The obvious problem is that not all countries can run an ecological deficit—for every deficit there must be a surplus somewhere else. Indeed, the apparent surpluses of large "underpopulated" countries such as Australia and Canada have already been absorbed by the ecodeficits of other countries.

Ecological deficits in turn highlight a particularly unsettling dimension of globalization. Deficit countries such as the United States, Western European nations, and Japan could not maintain, let alone expand, their consumer lifestyles if confined to the bio-output of their domestic territories. Such countries *need* globalization and expanding trade if they are to continue prospering. Little wonder that the governments of money-rich nations with ecodeficits are leading the neoliberal free-market parade. The dependence

of wealthy, powerful nations on other countries' ecological surpluses is potentially destabilizing geopolitically as global change accelerates, resources become scarcer, and developing countries' demands increase (Gurr, 1985; Homer-Dixon & Blitt, 1998).

I have already noted that material growth today is based, in part, on the depletion of natural capital. Anyone needing proof needs only refer to daily newspaper reports on ozone depletion, climate change, deforestation, fishery collapses, biodiversity loss, and so on. More concretely, the Worldwide Fund for Nature (2000) recently reported that its "living planet index" is declining in proportion to the increase in humanity's ecofootprint.

Regrettably, capital liquidation permanently reduces future carrying capacity—extinction/depletion is forever. 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" (quoted in Bartlett, 1996, p. 342) 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 eightfold increase in industrial activity expected over the next half-century is another matter altogether. Globalization is on a collision course with sustainability.

Conclusions: The Next Step in Human Evolution

> We stand at a critical moment in earth's history, a time when humanity must choose its future. As the world becomes increasingly interdependent and fragile, the future at once holds great peril and great promise. (From the *Earth Charter* Preamble)

We may stand at a time when humanity must choose its future but to do so means coming fully to understand our past. On its face, the record is not encouraging. The history of humankind right up to the modern period has been characterized by what I referred to above as the "Easter Island syndrome." The exuberant flowering of complex societies seems invariably to be followed by their unceremonious wilting and collapse.[7]

Tainter (1988) built a convincing case that any society becomes vulnerable to collapse when its social and biophysical resources are stretched too thin to cope with some major challenge, or when its investment in further complexity evolves beyond the point of diminishing returns. But this explanation of the *trigger* for collapse begs a deeper question. Why do human cultures and societies tend to expand to the limits of their resources and managerial capacities in the first place?

This article makes the case that the evolutionary imperative represented by the maximum power principle is a prime driver behind humanity's insistent expansionist tendencies. Humans have achieved unrivaled competitive superiority in appropriating the energy and material bounty of the earth. The problem is that the unique physical adaptations and behavioral predispositions that conferred great survival value on preindustrial cultures have become maladaptive today. The human enterprise, artificially swollen by exploitation of fossil fuels, continues to appropriate productive habitats, overexploit "natural capital," undermine the structure and function of ecosystems, pollute the air and water, and accelerate biodiversity losses. We are wreaking havoc on the ecosphere and, in the process, undermining the long-term human carrying capacity of the earth.

I also argue that the biological predisposition to expand wherever possible is exacerbated by prevailing beliefs and values. In the past 25 years, we have adopted a near-universal myth of "sustainable development" based on continuous economic growth through globalization and freer trade. Because the assumptions hidden in the globalization myth are incompatible with biophysical reality, the myth reinforces humanity's already dysfunctional ecological behavior. Nevertheless, constant repetition of the myth has so conditioned the population that the majority seems incapable of applying the basic rules of evidence to the growing cascade of data that refute it. Instead, we deflect uncomfortable truths by telling reassuring lies to each other and dismiss open-eyed globalization protesters as dangerous, uninformed rabble who must be crushed, if only "figuratively, of course" (Akst, 2001, sec. 3, p. 4). Meanwhile, living the myth is rending our social fabric, dissipating the ecosphere, and ultimately undermining world security. In the final analysis, it seems that both our genetic coding and the prevailing sociocultural coding (itself partially a product of genetic coding) are prejudiced against sustainability.

Some readers will dismiss the foregoing analysis on grounds that it plays to genetic determinism. Facing the fact that our genes exert some influence over our behavior and therefore our ultimate destiny may not bring comfort, but this does not make the idea wrong.

Surely it is by now incontrovertible that, like other species, *Homo sapiens* is genetically endowed with specific attributes, predispositions, and abilities. There can be no shame in acknowledging that we have historically used these qualities to our competitive advantage in ways that were conducive to our own sustenance, reproduction, and survival. Indeed, accepting this possibility is prerequisite to contemplating whether, with the emergence of modern industrial society, a historically adaptive strategy has become dysfunctional, even pathological: "Unless we confront the idea, however dangerous, of our human nature and species being and get some understanding of them, we cannot know what it is we might be alienated from or what emancipation might mean" (Harvey, 2000, p. 207).

And just what might our emancipation mean? Nothing less than being able to seize the opportunity to become truly human, to rise to our full potential as rational yet compassionate beings. Clearly, creating a new, more adaptive cultural myth requires that we first be able to see things for what they are, that we confront reality no matter how uncomfortable this might be: "If we are unable to identify reality and therefore unable to act upon what we see, then we are not simply childish but have reduced ourselves to figures of fun—ridiculous figures of our unconscious" (Saul, 1995, pp. 21-22). In short, finding effective solutions to the sustainability dilemma requires that we acknowledge both the distal and the proximal causes of our dysfunctional behavior and assert our independence from both genetic control and maladaptive myth. Let us finally seize collective control of our destiny. Success in this single act of social intelligence would at last distinguish humankind from species that are still wholly slaves to instinct.

To many this will seem an impossibly daunting challenge. Before succumbing to depression, however, it is well to remember that although humans can be selfishly individualistic and competitive, we are also generously social and cooperative. We have an abundantly diverse behavioral repertoire all of whose elements are under varying degrees of genetic and social control. Our dysfunctional cultural myth is failing partly because it emphasizes the darker end of the spectrum of human behavioral colors. The time has come to shift the emphasis to the brighter shades, those colors more likely to confer survival value on a finite planet. In short, human security and survival requires that we collectively consciously override those now maladaptive sociobehavioral tendencies that can lead only to civil strife, war, and ecological destruction in favor of adaptive predispositions that might ensure mutual survival. Consistent with this requirement, the fundamental values of global society must shift from individualism, narrow self-interest, and competition toward community, protecting our mutual interest in the global commons, and cooperation.

The good news here is that the basic intellectual framework of relevant rights and obligations is already in place. To take just one example with respect to interpersonal to international relationships, Brown (2000) articulated a tripartite concept of basic human rights. He argued that, at a minimum, all persons enjoy basic rights of bodily integrity; rights of moral, political, and religious choice; and subsistence rights. To ensure that these rights are respected, the world must come to agree that all persons have obligations to respect the basic rights of other persons. Our own security resides in respecting and enforcing the equivalent rights of others. Moreover, governments have default obligations to enforce or execute the obligations of individuals when the latter fail to do so. The international community has default obligations to enforce or execute the obligations of nations when the latter fail to do so. This simple formula provides the ethical framework for implementing and enforcing much more elaborate constructs such as the United Nations Universal Declaration of Human Rights, adopted by the General Assembly as long ago as December 1948 (but too-often forgotten in the strife-torn decades since).

Similarly, the *Earth Charter*, launched only in 2000, provides an ethical framework to govern human relationships not only with other humans but also with other life forms and the ecosystems that support us all. Consider just those principles that come under the heading of "Respect and Care for the Community of Life:"

1. *Respect earth and life in all its diversity.* Recognize that all beings are interdependent and every form of life has value regardless of its worth to human beings. Affirm faith in the inherent dignity of all human beings and in the intellectual, artistic, ethical, and spiritual potential of humanity.
2. *Care for the community of life with understanding, compassion, and love.* Accept that with the right to own, manage, and use natural resources comes the duty to prevent environmental harm and to protect the rights of people. Affirm that with increased freedom, knowledge, and power

comes increased responsibility to promote the common good.

3. *Build democratic societies that are just, participatory, sustainable, and peaceful*. Ensure that communities at all levels guarantee human rights and fundamental freedoms and provide everyone an opportunity to realize his or her full potential. Promote social and economic justice, enabling all to achieve a secure and meaningful livelihood that is ecologically responsible.
4. *Secure earth's bounty and beauty for present and future generations*. Recognize that the freedom of action of each generation is qualified by the needs of future generations. Transmit to future generations values, traditions, and institutions that support the long-term flourishing of earth's human and ecological communities.

These principles recognize that we humans are unlikely to conserve anything for which we do not have love and respect, empathy and compassion. Indeed, it might be argued that for ecological sustainability, we must come to feel in our bones that the violation of nature is a violation of self.

Obviously, global culture today drifts a disheartening distance away from the high ethical and moral plane reflected in all such idealistic declarations. The vocabulary for a new cultural myth for global sustainability has yet to be fully articulated. How many wealthy countries are seriously considering the implications of an "economy of enoughness," for example? Those who live materially excessive lives are not yet generally prepared to contemplate the possibility that they might actually have to *reduce* consumption (or at least their use of energy and materials) that others may live at all. (As U.S. President George Bush said at the 1992 Rio Summit, "The American way of life is not up for negotiation.") On a finite planet, significantly improved living standards for the impoverished can be accommodated with present technologies 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.

This raises a final critical question. Is there sufficient political will at the international level to construct the policy framework required for cooperative implementation of a global sustainability agenda? Is there any realistic hope that the required shrinkage and redistribution can be achieved in the time available when the mythos of Western industrial culture and the logic of expansionist economics still encourage individuals and nations alike to behave as self-interested utility maximizers? (The inevitable result of everyone trying to maximize his or her use of resources on a finite planet is the competitive overexploitation of common-pool resources; Ophuls & Boyan, 1992.)

The early evidence is disheartening. Indeed, some analysts suggest that the prevailing development paradigm has been intentionally designed to serve powerful interests in full knowledge of the social and environmental prejudice to others, that it is serving its purposes well, and that the present beneficiaries will resist by all possible means any effort to achieve a socially just ecological sustainability. Consider the words of U.S. State Department analyst George F. Kennan in 1948:

> We have about 50% of the world's wealth but only 6.3% of its population. This disparity is particularly great as between ourselves and the peoples of Asia. In this situation, we cannot fail to be the object of envy and resentment. Our real task in the coming period is to devise a pattern of relationships which will permit us to maintain this position of disparity without positive detriment to our national security. To do so, we will have to dispense with all sentimentality and day-dreaming; and our attention will have to be concentrated everywhere on our immediate national objectives. We need not deceive ourselves that we can afford today the luxury of altruism and world-benefaction...We should stop putting ourselves in the position of being our brothers' keeper and refrain from offering moral and ideological advice. We should cease to talk about vague and—-for the Far East—-unreal objectives such as human rights, the raising of the living standards, and democratization. The day is not far off when we are going to have to deal in straight power concepts. The less we are then hampered by idealistic slogans, the better. (Kennan, 1948).

Hard-edged, unambiguous, fully transparent, and although referring specifically to the United States' relationship with Asia, Kennan's policy advice provides a more revealing context for recent world history than anything the prevailing popular myth has to offer. This statement is primitive "maximum power" in full flood. Regrettably, if ecological constraints on human activ-

ity are indeed real and serious, and the world adopts any such approach to survival based on "might is right," then there is no hope for a successful transition to sustainability. Global society will collapse in chaos.

It is worth restating, therefore, that the sustainability conundrum poses the ultimate challenge to human intelligence and self-awareness, those vital qualities we humans claim as uniquely our own. *Homo sapiens* will either rise above mere animal instinct and become fully human or wink out ignominiously, a guttering candle in a violent storm of our own making. It would be a tragic irony if, in the 21st century, this most technologically sophisticated of human societies finally succumbs to the unconscious urgings of fatally self-interested primitive tribalism. The cycle of societal collapse will have closed once again, this time on the global scale. Our only beacon of hope is the potential triumph of enlightened reason and universal compassion over scripted determinism, whatever its source. Moving beyond the worst inclinations of our genes would herald a whole new phase in human evolution.

Notes

1. Parts of this section were revised from Rees (2001a, 2002).

2. 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.

3. Ecofootprint analysis estimates the consumptive demand of a population or technology in terms of the ecosystem area appropriated to supply all measurable biophysical goods and services. A fuller explanation follows in a later section.

4. In advanced economies, 95% or more of the money in circulation is actually loaned into existence by financial institutions. Notes and coins issued by government account for the residual.

5. Parts of this section were revised from Rees (2000, 2001a).

6. It can also serve as an alternative to GDP as a measure of economic scale.

7. We have a major advantage over previous cultures in that we know what happened to them.

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