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Sustainability and the Global Commons

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Abstract : The first picture of Earth from space showed a tiny, fragile, blue sphere. Above all, the planet was obviously finite. Despite this evidence, the restricted view of Earth from Earth is that sustained development (*i.e.*, growth) is possible on a finite planet. However, to live sustainably, humankind must determine Earth's carrying capacity and live within that limit. The ecologically acceptable number of inhabitants will depend upon the quality of life people seek and the size of the safety factor that will be accepted as necessary to avoid exceeding Earth's carrying capacity. Nature exacts severe penalties on those individuals and societies that exceed carrying capacity (*i.e.*, overuse of natural resources). The central but inadequately discussed assumption of sustainable use of the planet is that humankind can reduce the suffering resulting from natural selection and also develop a mutualistic relationship with the biospheric life support system and with members of its own species. Scientific evidence, reason, and compassion for all forms of life may well create sustainability. Of course, biological evolutionary processes will sustain life on Earth despite prodigious loss of individuals and species. Over 4 billion years of evidence indicate that this process works. On the other hand, no robust evidence is available that sustainable use of the planet by *Homo sapiens* is even possible, but social evolution of human society may make it so. A key component is managing the global commons for sustainable use without abuse.

Key words : Biological evolution, Social evolution, Sustainability, Resource wars, Carrying capacity, Scientific evidence, Global commons.

Introduction :

If we are to correct the consequences of the world's actions, we must understand the machinery that accounts for these consequences.

Garrett Hardin

Tragedy is the price of freedom in the commons . . . In other words, in a crowded world survival requires that some freedom be given up.

Garrett Hardin

Role of Scientists

Scientists can make a major contribution to the quest for sustainable use of the planet, but their contributions are diminished by the necessity of continually defending theories, such as global warming and evolution, that are widely accepted by mainstream, credentialed scientists. Science cannot flourish when it is sacrified to political expediency or rejected because it appears to threaten religious beliefs. Science can and does flourish because of the process of science, which includes peer review and validation of evidence; it is diminished by ideological attacks not based on verifiable evidence.

Biological evolution (Darwinian) produced the world in which humankind began; a combination of biological and social evolution produced the world humankind now inhabits; and social evolution will determine whether humankind can live sustainably. The transition to sustainable use of the planet will be endangered if short-range goals continue to drive out long-range ones.

The Global Commons

As Hardin (1968) remarks in his prophetic widely cited article, a commons that is freely accessible to all will be over utilized by those with no conscience, simultaneously reducing the share of those with a conscience. As Cairns (2003) notes, economic globalization has resulted in all the world's resources being available to any individual or organization that has enough money to gain access to them. Predictably, this situation has resulted in a 20% ecological overshoot (*e.g.,* Wackernagel *et al*., 2002), which began in the last quarter of the 20^{th} century. Clearly, this overshoot cannot continue since society may soon pass a point of no return, even if it has not already done so. Xie (2006) has noted: (1) human society must remain aware that the overall condition of the global environment has not improved, (2) China is resolved to change the practice of polluting first and cleaning up later, (3) China is striving to build a resource-saving, environmentally friendly society. May I live to see global society share these goals with China and, above all, implement them. In the second foreword, Narain (2006) recounts Mahatma Gandhi's response to the question of whether he would like free India to be as "developed" as the country of its colonial masters, Britain. "No", replied Gandhi, "If it took Britain the rape of half the world to be where it is, how many worlds would India need?" How prophetic! Humankind is now living temporarily on 1.2 worlds and has access to only 1.0. Society should be reassured that policymakers in the planet's two most populous countries have identified and stated the crucial issues so concisely. Above all, neither has relied on not-yet-developed technologies to enable continuation of unsustainable practices. Events in these reemerging planetary powers persuaded WorldWatch to focus State of the World 2006 on specific countries rather than issues (Flavin, 2006). As Flavin and Gardner (2006) note, "The economic successes of China and India are based not on the richness of their natural resources, but on decades of investment in their people." However, China had a 24% growth in ecological footprint size in 2002, while India's was 17%. China's footprint/person in 2002 was 1.6 global hectares, while India's was 0.8. In contrast, the United States had a footprint size of 9.7 in 2002 (Flavin and Gardner, 2006). Obviously, equity and fairness require that some adjustments in national footprint size be made. Technology will not solve this problem, but could contribute to the solution. Science can provide valuable information about the health of the global commons but not how to regulate access.

Ecosystem Monitoring of the Global Commons

Environmental monitoring is at least a half century old, but has typically monitored, in depth, systems far smaller than the global commons. As a consequence, many methods and procedures based on smaller systems are available and have been field tested and validated. Examples of illustrative unresolved ecosystem monitoring issues follow.

(1) Ecosystem monitoring, to be persuasive, must be carried out by credentialed scientists who generate verifiable evidence. Ideally, scientists should be able to carry out, analyze, and communicate their results to colleagues via professional journals and meetings without

censorship by political ideologues and special interest groups.

(2) Since ecosystems do not conform to political boundaries, much cooperation will be needed for monitoring systems that transcend political boundaries (e.g., air and water).

(3) If the monitoring system generates evidence of ecosystem damage, prompt corrective action must be taken. An organization must be in place that is authorized to initiate action and which has a competent staff to do the work.

(4) Since item (3) will require significant operating funds on a continuing basis, a source of revenue must be available from either one or more political systems, or from fees paid for use of the commons.

(5) Until the ecological overshoot is eliminated, humankind must reduce its demands upon the global commons until adequate ecological capital has accumulated. Monitoring this build up of capital will place new demands upon scientists and political leaders.

(6) Analysis and synthesis typically follow any data gathering endeavor, but the scale of data generated from monitoring the global commons will probably exceed earlier monitoring efforts by an order of magnitude or more. Fortunately, state-of-the-art computers are available for this effort.

(7) As always, data quality assurance and control will be major concerns. Scientists are well prepared to cope with both these concerns if given adequate resources and time.

(8) A crucial human value judgment involves countries living beyond their ecological means. The United States, Europe, Japan, India, and China all have ecological deficits (*i.e.*, living beyond their ecological means). This overshoot is a consequence of importing resources and discharging wastes (*e.g.*, carbon dioxide) into the global commons. The above listing, including the European Union, utilizes 75% of the planet's biocapacity, leaving just 25% of the biocapacity for all other nations. Unless this awkward problem is resolved, fair and equitable use of the global commons will not become a reality.

(9) Ecosystem resilience (*i.e.*, ability to recover from stress) is not identical throughout the global commons. This difficult research problem is not studied much. This critical information is needed for making policy on sustainable use of the planet, and time is short to gather it.

(10) Arguably, the most probable intractable problem is the disproportionate per capita and per nation use of biocapacity. Neither individuals nor nations will be anxious to accept a much smaller share of planetary resources. Neither science nor technology can resolve this problem – only human conscience can resolve it. If social evolution is not up to this challenge under present circumstances, perhaps a few global catastrophes will help things along.

(11) Population stabilization is essential. The size of the resource base determines the carrying capacity of the planet, and the ecological overshoot affirms that humankind has been over utilizing its resource base. One can be confident that the human population will stabilize. The big unknown is whether starvation and misery will be the major driving factor or social evolution. Stabilizing the human population

does not mean arriving at a fixed number but, rather, finding the number of people that Earth's resources will support sustainably (*i.e.*, carrying capacity). Since the carrying capacity varies, so must the human population. All ecosystems are dynamic and, thus, continually changing. Carrying capacity can be monitored, but prudence dictates including a realistic safety factor, especially in early developmental stages of the model.

(12) The structure and function of most dynamic ecosystems remains stable despite continual species succession. This process involves equilibrium between the rates of colonization and decolonization. As a consequence, a large reservoir of potential colonizing species ensures that the most suitable species for that time and place will be selected. The process is further improved if sources of colonizing species are not too distant. The ecological literature has a large body of evidence on the relationship between biological preserve size and the number of species it can support. Well designed ecological corridors permitting movement of species among biological preserves are also beneficial. Ecological restoration and natural recovery from damage both depend upon adequate sources of colonizing species.

Practically no area of the planet is unaffected by human activities, yet very little is known about the condition of the 30+ million other life forms with which humans share the planet. However, the realization that they collectively constitute the biospheric life support system may correct this situation before it is too late. Society will not likely find out all that is needed in time to prevent global ecological disequilibrium, which has been underway for some time. However, a vast body of scientific knowledge is already available and should be used. Ideally, immediate action might "buy" humankind the time necessary to fill in some of the informational gaps. All scientists should participate in this effort.

Although many species are endangered, a few have taken advantage of opportunities provided by humans. These invasive species have displaced many indigenous species, disrupted agricultural production, and even invaded industrial cooling systems (*e.g.*, Asian clams). Most invasive species were transported or introduced deliberately or inadvertently by humans. Some invasive species were deliberately imported to resolve problems created by other invasive species. Others were simply transported inadvertently by the vast system established to support the global economy. Stressed and damaged ecosystems are especially vulnerable to invasive species. As the number of stressed ecosystems increases, concomitantly more opportunities will emerge for both invasive species and indigenous species resistant to human control.

The global commons is vulnerable to disruption by both invasive species and opportunistic indigenous species. Thus, the resources of the global commons are diminished, reducing the carrying capacity for humans. Management of the global commons is virtually nonexistent and not amenable to rapid development. However, sustainable use of the planet requires a healthy, dependable global commons, which is not likely to be a reality soon, even if steps are taken immediately to repair the ecological damage that has been done.

The Battle for Use of the Commons

The commons has been available at no cost for virtually all of human history. England dominated the oceanic commons for many years because it had the world's most powerful navy. The major concern at that time was the ability to transport goods from colonies to the mother country. Extraction of resources, especially petroleum, was minimal compared to the present. However, the ecological integrity of the global commons now is increasingly threatened by human activities. In short, both natural capital and ecosystem services have been lost, and the rate of loss is likely to continue unless major remedial measures to eliminate unsustainable practices are taken. Three components are present in the battle for enlightened, sustainable use of the commons.

(1) scientific component

The oceanic commons is a vast system with an information base that does not match the magnitude of the problem. However, ample evidence is available on such components as oceanic fisheries and coral reefs to justify major changes in present policies. Individuals and organizations that cry for more research to justify inaction should be required to state formally and precisely how the new information will influence decision making and why the new information will not be ignored as much quality evidence from mainstream science is being ignored (Reid, C., 2006; Reid, J., 2006; Dornelas *et al.*, 2006; Pandolfi, 2006).

The global oceanic commons involves many unknowns. Some are clearly global (*e.g.*, acidification) – others appear to be regional. For example, in the 1970s, about 1,300 beluga whales inhabited Cook Inlet near Anchorage, Alaska, USA. In 2005, the estimate was 278. Scientists are puzzled about the cause of the decline (Pemberton, 2006). Neither qualified personnel nor research funding are unlimited. Setting priorities, goals, and research priorities is a systems-level problem.

Most scientific research is carried out over comparatively short time frames compared to long-term oceanic cycles. For example, the periodic warming of the Pacific Ocean, known as El Niño, can reduce crop yields in Africa. In some years, food supplies for approximately 20 million people can be endangered (Gana, 2006). Typically, El Niño occurs every 3-7 years, but global warming and other types of climate change could alter the present cycles. Clearly, this phenomenon should have a high priority, but will require many years to determine if the cycle has changed. Because of the long-term nature of the research, investigations should be the responsibility of an institution, just in case principal investigators might change.

(2) political component

One disturbing article I have read recently covers the results of *The Los Angeles Times*/Bloomberg poll and *The New York Times*/CBS News poll. The primary message is that half the US population is incapable of acquiring, processing, and understanding information (Roberts, 2006). This situation explains, in part, why politicians with few or no scientific credentials can denigrate science and describe it as just another value judgment, instead of a carefully structured and validated process.

Recently, biofuels that could replace oil and give the United States energy independence have received much attention. However, ecologist Pimentel and engineer Patzek (2006) carried out energy input-yield ratios of producing ethanol from corn, switch grass, and wood biomass, as well as for producing biodiesel from soybean and sunflower plants. The results in terms of energy output compared with energy input follow : (1) corn requires 29% more fossil energy than is in the fuel produced, (2) switch grass (recently endorsed by US President Bush) requires 45% more fossil energy than is in the fuel produced, (3) wood biomass requires 57% more fossil energy than is available in the fuel produced. Data for biodiesel production in terms of energy output compared to energy input follow: (1) soybean plants require 25% more fossil fuel than is in the fuel produced, (2) sunflower plants require 118% more fossil energy than is in the fuel produced.

How can an automobile culture such as the United States ignore such evidence? Diamond's (2005) superb book examines some reasons for both success and failure. The inhabitants of tiny Easter Island could surely see their forests disappearing, but did not respond adequately and the result was catastrophe. In contrast, Japanese shoguns, in the 1600s, coped with deforestation due to an exploding population by increasing wood production, using light timbered construction, developing fuel efficient stoves, and using coal to replace wood as fuel. At present, Japan is more than 70% forested, despite its large population. However, Japan imports much wood and will undoubtedly have to take additional measures as rapid deforestation occurs in other parts of the world.

One lesson of history is that humankind must take environmental problems seriously. Second, Nero (who purportedly fiddled while Rome burned) demonstrated what happens when the elite chooses to insulate itself from the consequences of its actions – the elite do not feel deprived until the support system is destroyed and catastrophe is imminent. Durant and Durant (1968) have remarked that maldistribution of wealth is partly readjusted by revolution or social means (*e.g.*, heavy tax on large incomes). A few countries are using a disproportionate amount of the resources of the global commons, as are a very few individuals. A plausible preview of the coming intense resource wars at the nation-state level was demonstrated when Saddam Hussein ordered that oil wells be set on fire rather than let the US-led coalition forces have them. However, all sorts of societal infrastructures are vulnerable to guerrilla warfare. Neither nation-state nor guerrilla warfare is likely to result in fair and equitable distribution of the resources of the commons. Societal evolution based on the mistakes of earlier societies might just bring humankind out of the present muddle.

(3) communication

Communication within the global scientific community is essential. Many barriers, such as language, sense of urgency, level of funding, pressures from other professional obligations, already exist. Politics can interfere with collegial relationships, such as scientific cooperation. For example, in the United States, political ideology has disrupted the free and open exchange of ideas between government scientists and both academic scientists and the general public. Internationally, scientists have had a collegial relationship practically all of the time. A relationship based on the scientific process and verifiable evidence should be this way. Only when political ideology and values based on faith attempt to intervene in the evidence-based process have difficulties arisen. All these distractions prevents a reexamination of "status quo" values that no longer make sense. Unrestrained consumerism is not appropriate on a finite planet with finite resources. The global commons is already badly stressed and overused, and a free and open discussion of this situation is long overdue.

Concluding Statements

(1) The means to reduce anthropogenic greenhouse gases are available and have been for decades. Lacking are the leadership and societal will to initiate approaches. Research commissioned by *The Independent* (McCarthy, 2006) provides evidence that the accumulation of greenhouse gases in the atmosphere has now crossed a threshold beyond which really dangerous climate change is likely to be unstoppable. This happening will further damage the global commons, as well as resulting in increased hunger and water shortages. Tom Burke, a visiting professor at Imperial College, London, UK, warns that the planet has now entered a new era of dangerous climate change. In short, posterity can no longer count on a safe climate.

(2) Humankind's global ecological footprint has exceeded global biocapacity since the 1980s. This trend continues (recent evidence can be obtained from the Global Footprint Network internet site).

(3) Data on acidification of the oceans are not as robust as that for global warming. However, oceans represent a huge portion of the global commons, so the thought of serious damage to them is appalling. For example, the United Nations reports that 7 of the top 10 marine fish species are already fully exploited or overexploited, and world fish consumption may rise by more than 25% by 2015 (Brown, 2006). Brown (2006) notes that Canada's government reports that ocean temperatures in the North Atlantic hit an all-time high, raising concerns about the effects of climate change. The damage to coral reefs and oceanic current flow patterns are also well documented.

(4) These three deleterious effects upon the global commons are accepted by mainstream science, but have not elicited an adequate political response. In the United States, one of the leaders in world science, the origin of the universe is now a white hot center of national politics (Overbye, 2006). Worse yet, George C. Deutsch, a 24-year old National Aeronautics and Space Administration (NASA) political appointee with no scientific background, told a designer working on a NASAWeb project that the "big bang is not proven fact, it is opinion." Deutsch sent an e-mail message that it is not NASA's place to make a declaration about the origin of the universe that discounts intelligent design. Also, NASA headquarters removed a reference to the future death of the sun because "NASA is not in the habit of frightening the public with gloom and doom scenarios." Political ideology uses the word *theory* in a derogatory context – it is merely an opinion or guess despite its high status in the world of science. Science news is now regarded by some bureaucrats as political news and,

therefore, must be carefully managed. Posterity may lead an impoverished life because political disruption of the scientific process leads to "feel good" news rather than testable scientific predictions. At stake is sustainable use of the planet, enlightened scientific management of the commons, and the future of science.

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