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Book Review

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An Introduction to Ecological Economics (Second Edition).

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Boca Raton FL: CRC Press (Taylor & Francis Group), Jan 2015, 337p., $99.95.

As we rush headlong into the Anthropocene age, when humans dominate and disrupt the earth and its natural systems, governance of evolution becomes increasingly imperative. "Sustainable development" of some sort will be necessary, as well as new economic theory to back it up. "Ecological economics" is a prime candidate for titling this new economics.

This introduction is provided by several long-time leaders in the field—notably Robert Costanza, co-founder of the International Society for Ecological Economics in 1989 and author or co-author of over 500 articles and 27 books, and Herman Daly, who has touted "steady-state economics" for more than 40 years. It not only offers a compact overview of the principles of ecological economics, but an outstanding survey of planetary boundaries and the troubled human condition, an illuminating historical view of the co-development of economics and natural science, and a long concluding section on needed institutions and policies.

If there is a single take-away idea from this important book, it is the necessary transition from "Empty-World Economics" (relatively few people and abundant natural capital) to "Full-World Economics" (many billions of people and increasingly scarce resources). The details in each of the four long chapters are well-worth outlining.

Chapter 1: Humanity's Current Dilemma

"Severe anthropogenic damage began when humans learned to apply highly entropy-increasing technological processes to agriculture. This was sharply escalated by factory production in Europe during the Industrial Revolution." (p3) Early public policy responses were feeble to non-existent, allowing polluters to emit wastes into the common property resources of air and water. Today, there are four basic problems that need innovative policies and management instruments: 1) large and growing human populations that exceed Earth's

carrying capacity; 2) rapidly increasing inequality within and between nations; 3) new technologies that deplete the Earth of its resources, and whose unassimilated wastes poison air, water, and land; 4) land conversion that increases soil erosion, destroys habitat, and accelerates loss of biodiversity.

The authors neatly summarize the evidence of global limits and planetary boundaries:

1. **Human Biomass Appropriation:** increasing deforestation, urban encroachment on agricultural land, blacktopping for roads and parking lots, pollution, and desertification.
2. **Climate Change:** nine out of ten of the hottest years on record occurred since 2000 [NOTE: 2014 topped them all]; economists are still "almost unanimous in persisting in externalizing the costs of CO_2 emissions"; there are few positive exceptions to offset the negative impacts of global warming.
3. **Ozone Shield Rupture:** the global sink capacity to absorb CFC pollution has been exceeded; the single Antarctic ozone hole has now gone global, and the global ozone layer is thinning far faster than models predicted; every 1% decrease in the ozone layer results in 5% more of certain skin cancers; potentially more serious is the depression of our immune systems and upsetting normal balances in natural vegetation.
4. **Land-System Change:** land has been degraded by civilization for thousands of years; over the past 40-50 years, the scale has grown to about 0.8% per year, and the degradation is largely irreversible; some 40% of cultivated land is experiencing soil erosion, overgrazing, or reduction in fertility.
5. **Biodiversity Loss:** the majority of the world's most species-rich habitats, such as tropical forests and coral reefs, have been destroyed or significantly impacted; the extinction rate has increased 100 to 1000 times that of background levels, and is projected to increase another tenfold by 2100.
6. **Ocean Acidification:** the rate of acidification is at least 100 times faster than at any time in the last 20 million years, affecting coral and other marine organisms, due to dissolution of some 25% of human-emitted CO_2, which increases acidity of surface seawater.
7. **Freshwater Loss:** humans have altered almost every river worldwide, and some 25% of global river flows never reach the ocean due to alternative uses; also, groundwater aquifers are quickly being drained; some 20-50% of water that flows through rivers is needed for functioning of critical ecosystem services; crossing thresholds may include collapse of regional hydrology cycles, shifting or shutdown of the monsoon system, or conversion of the Amazon rainforest to savannah.
8. **Nitrogen/Phosphorous Eutrophication:** the majority of new nitrogen produced to enhance food production via fertilizers ends up in waterways and coastal zones; inflow of phosphorous into oceans exceeds natural background levels by 8-9 times, leading to anoxic dead zones of marine life; interaction between nitrogen and phosphorus can cause abrupt shifts in Earth subsystems.
9. **Atmospheric Aerosol Loading:** aerosols have a critical effect on both the climate system and human health at regional and global scales; they also lead to crop damage, forest degradation, and loss of freshwater fish.

10. **Chemical Pollution:** major forms of chemical pollution include radioactive compounds, heavy metals, and a wide range of organic compounds of human origin; of the 80,000 chemicals in commerce, 200 are known to be neurotoxic in humans, and 1000 are known to be neurotoxic in experiments.

In sum, "A large part of the problem lies in the way we have organized our intellectual activities. The problems outlined earlier are global, long-term, and they involve many academic disciplines… The academic disciplines are today still very isolated from each other and this contributes to the difficulty of addressing the questions posed here. But it was not always so. Until roughly the beginning of the 20th century, economics and the other sciences were relatively well integrated." (p.24)

The following chapter "traces the early, pre-fragmentation history of economics and the natural sciences as they continually interacted with each other."

Chapter 2: Historical Development of Economics and Ecology

Discusses pros and cons of early pioneers: Adam Smith (1723-1790) and the "invisible hand," Thomas Malthus (1766-1834) and his model of population growth and collapse, David Ricardo (1772-1823) on how landlords receive a rent from land ownership, Sadi Carnot (1796-1832) and Rudolf Clausius (1822-1888) on the first and second laws of thermodynamics, Charles Darwin (1809-1882) and the evolutionary paradigm, John Stuart Mill (1806-1873) and the steady-state metaphor, Karl Marx (1818-1883) and the ownership and control of resources under capitalism, W. Stanley Jevons (1835-1882) on efficient use of resources that can result in increased total use, Ernst Haeckel (1834-1919) on ecology as the study of the economy of nature, Alfred J. Lotka (1880-1949) on looking at systems from an energetic point of view, Alfred C. Pigou (1877-1959) on market failure seen as costs and benefits not included in market prices, and Harold Hotelling (1895-1973) on the efficient use of resources over time and conditions where conservation occurs.

By the time of renewed environmental awareness in the 1970s, economics had become highly specialized, and isolated from the natural resource (i.e. land) component of the classic triad of land, labor, and capital. Various mid- to late-twentieth century pioneers in reintegrating ecology and economics are then discussed: Ludwig von Bertalanffy (1901-1972) on general systems theory, Garrett Hardin (1915-2003) on the tragedy of the commons, Elinor Ostrom (1933-2012) on common pool resources, Howard T. Odum (1924-2002) on energetics and systems, Nicholas Georgescu-Roegen (1906-1994) on the entropy law challenging belief in economic progress, Kenneth Boulding (1910-1993) on the economics of the coming closed-system spaceship earth, Herman Daly (1938-) on steady-state economics as an antecedent of ecological economics, C. S. Holling (1930-) on adaptive environmental management, and Paul Ehrlich and Peter Raven on coevolution of ecological and economic systems.

Chapter 3: Principles And Objectives Of Ecological Economics

Ecological economics is a dynamic, constant changing set of questions, advocating "a fundamentally different, transdisciplinary vision of the scientific endeavor that emphasizes dialogue and cooperative problem solving. It tries to transcend the definition and protection of intellectual turf that plagues the current disciplinary structure of science… It is not a

question of 'conventional economics' vs. 'ecological economics' but rather conventional economics as one input (among many) to a broader transdisciplinary synthesis." (pp. 87-88)

1. **Basic Points of Consensus in the Ecological Economics Vision:** Earth as a thermodynamically closed system with the human economy as a subsystem; need for a sustainable planet with a high quality of life for all humans and species; recognition that some processes are irreversible thus requiring a precautionary stance; appreciation of other modes of thinking and actively seeking a constructive dialogue because the subject is too big and complex.

2. **Three Basic Interrelated Problems:** sustainable scale, efficient allocation with relative prices determined by supply and demand in competitive markets, and fair distribution among present and future generations (such that the degree of inequality is limited within some acceptable range, by policy instruments such as taxes and welfare payments).

3. **From Empty-World Economics to Full-World Economics:** "the human economy has passed from an era in which human-made capital was the limited factor in economic development to an era in which remaining natural capital has become the limiting factor" (p.93); policy should thus be designed to increase the productivity of natural capital and its total amount.

4. **Why This Turning Point Has Not Been Noticed:** the world has rapidly gone from relatively empty to relatively full, but "there has not yet been time for empty-world economists to die; meanwhile they have been cloning themselves faster than they are dying by maintaining tight control over their guild…(and) full-world economics is not yet accepted as academically legitimate" (pp.94-95)

5. **Complementarity, Substitutability, and Fundamental Limits:** "productivity of human-made capital is more and more limited by the decreasing supply of complementary natural capital" (what good is a fishing boat without fish, or a sawmill without a forest?).

6. **Ecosystems, Biodiversity, and Ecosystem Services:** ecological systems play a fundamental role in supporting life on Earth at all hierarchical scales; they form the life-support system without which economic activity would not be possible (the 1994 value of ecosystem services, ranging from $16 to $54 trillion a year, was estimated by Costanza et al. in 1997; in the 1997-2011 period, we have lost >$20 trillion in the value of ecosystem services due to land use change).

7. **Defining and Predicting Sustainability in Ecological Terms:** definitions of sustainability are usually predictions based on actions that one hopes will lead to sustainability, but no system has an infinite life span.

8. **Growth vs. Development:** growth destroys natural capital and beyond some point will cost more than it is worth; development, or qualitative improvement, is not at the expense of natural capital; "there are clear economic limits to growth but not to development."

9. **Sustainability and Maintaining Natural Capital:** To achieve sustainability, we must incorporate natural capital, and the ecosystem goods and services that it provides, into our economic and social accounting, and into our systems of social choice.

10. **Population, Carrying Capacity, and Well-Being:** Ecological economics is unequivocal about limits to the carrying capacity of the Earth for human populations. But there are questions as to the number of people that can be supported, their standard of living, and whether food production will be adequate. Better measures of well-being and health of both economic and ecological systems are critical.

"A new model of the economy consistent with our new full-world context would be based clearly on the goal of sustainable human well-being (p.160)."

11. **Gross Domestic Product and Alternatives:** GDP is widely seen as a sign of a healthy economy and of human well-being, but this "reductionist view of reality" measures only some aspects of welfare. Discusses "Hicksian income" as a better measure, the measure of economic welfare (MEW) proposed in 1972 by Nordhaus and Tobin, and the Index of Sustainable Economic Welfare (Daly and Cobb, 1989; renamed in 2007 as the Genuine Progress Indicator). Charts of GDP and GPI per capita from 1950 through 2010 are shown for 17 countries; the GPI indicator generally shows little or no progress.

12. **Toward a Measure of Total Human Welfare:** GPI provides a far better measure of economic welfare, but "falls far short of measuring total welfare (GPI measures how much is produced and consumed, tacitly assuming that more consumption leads to greater welfare). A different approach would look at actual well-being, e.g. Manfred Max-Neef's nine categories of axiological human needs (1992): subsistence, protection, affection, understanding, participation, leisure, creation, identity, and freedom. "A new model of the economy consistent with our new full-world context would be based clearly on the goal of sustainable human well-being." (p.160)

13. **Technological Optimism vs. Prudent Skepticism:** Current economic policies are based on the assumption of continuing and unlimited material economic growth. An opposing line of thought assumes that technology will not be able to circumvent fundamental energy and resource constraints, and that unlimited growth eventually becomes cancerous. Malthus's predictions have not come to pass yet for the entire world, but many parts of the world are now in a Malthusian trap. Will new sources of energy and techniques of conservation step in and save the day, and keep economies growing? The optimists say yes, while the technological skeptics say no. "Ultimately, no one knows. Both sides argue as if they were certain, but the most insidious form of ignorance is misplaced certainty." (p.174) Whatever the case, a more ecological approach to economics and a more economic approach to ecology will benefit our life-support systems. Given high uncertainty about this issue, and the enormous size of the stakes, we should not bank on technology's ability to remove resource constraints. "If we guess wrong then the result is disastrous."

14. **Problems of International Free Trade:** It is widely assumed that trade liberalization leads to win-win solutions. From the broader perspective of ecological economics, free trade and free capital mobility raise many issues not acknowledged by conventional economists. It conflicts with basic national policies of getting prices right, more just

distribution, fostering community, controlling the macroeconomy, and keeping scale within ecological and sustainable limits. "Sustainable development means living within environmental constraints of absorptive and regenerative capacities." Trade among nations or regions offers a way of loosening local constraints by importing environmental services, which can become destructive.

Chapter 4: Institutions, Instruments, and Policies

A survey of some general and specific policy ideas that flow from the previously-stated principles, and instruments that may be useful in implementing these policies. "What is needed is deep discussion and consensus about long-term goals, not constant quibbling over short-term details."

1. **Need for a Shared Vision:** "If humanity is to achieve a sustainable and desirable future, we must create a shared vision detailing what we as a society want to sustain… This vision must incorporate a diversity of perspectives and be based on principles of fairness, respect, and sustainability." (p.199) "Developing this shared vision is an essential prerequisite to generating any movement toward it. The default vision of continued, unlimited growth in material consumption is inherently unsustainable, but we cannot break away from this vision until a credible and desirable alternative is available." (p.215)

2. **Scenario Planning:** Scenarios are needed for dealing with uncertainty, based on assumptions that the future is unlike the past and shaped by human choice and action, that exploring possible futures can inform present decisions, that there are many possible futures, and that scenario development of possibility spaces involves rational analysis and creative thinking. Examples are the Great Transition Initiative of the Tellus Institute and four futures for New Zealand. [Also see "Scenarios for Australia in 2050" by Robert Costanza and ten others, Journal of Futures Studies, March 2015, pp.49-76.]

3. **Urgent Need for a New Development Paradigm (NDP):** Rapidly urbanizing areas are a critical focal point for NDP implementation, due to increasing concentrations of populations, assets, and economic activities. Urban areas are the key drivers of global consumption and production, and are most at risk from global environmental change. Multiple changes across legal and regulatory frameworks will be necessary to mainstream the NDP.

4. **Ecological Tax Reform:** Shift the tax base from value-added labor and capital (which is something we want to encourage) to entropic throughput of resources extracted from nature (depletion) and returned to nature (pollution). This internalizes external costs and raises revenue more equitably.

5. **Limit the Range of Inequality in Income Distribution:** Complete inequality is unfair, as is unlimited inequality. We can see fair limits with a minimum and a maximum income within a range of, say, 100. "When rich and poor are separated by a factor of 500, they become almost different species" (p.205).

6. **Technology Assessment Policies:** "Technological laissez-faire may have been appropriate in a relatively empty world… (but) we no longer can afford to let survival depend upon the benevolence and wisdom of naïve technological enthusiasts" (p.228).

Before adopting new systems, it would be desirable to examine the full life cycle of the technology—an elementary precaution to save us from disasters. A comprehensive tracking of wastes is also needed before adopting new systems.

7. **Redirecting Technology toward Sustainable Solutions:** Much R&D is now performed by corporations driven by economic incentives. In contrast, cooperative public sector investment made freely available for all would eliminate the costs of protecting intellectual property rights and focus on provision of public goods and green technologies. Many economists worry that some nations would free-ride on investments of others, but free-riding on technologies that protect the environment benefits countries that made the initial investments.

8. **Habitat Protection and Intergenerational Transfers:** Many options exist for selecting the stock of environmental resources (rainforests, wetlands, lakes, estuaries, coral reefs, etc.) to be passed along to future generations through purchase, easements, and gifts. "A major challenge will be gaining acceptance for large-scale current sacrifices that will produce uncertain benefits in an uncertain future." Another complicating factor is the need for consensus on goals.

9. **Regulatory Systems vs. Incentive-Based Systems:** Most regulatory environmental control instruments now in place are characterized by inefficiency. Rather than casting policy instruments in terms of regulatory vs. incentive systems, it is more constructive to look for conditions where incentives yield better results. "The urgent need for alternative approaches to environmental management that are less costly and more efficient than traditional approaches has long been recognized" (p.239). Incentive-based instruments include taxes on pollution emissions, subsidies for pollution abatement, marketable permits for emissions, and creating economic incentives for acting in the common interest.

10. **Three Policies to Achieve Sustainability:** a broad natural capital depletion tax, the Precautionary Polluter Pays Principle to assure that full costs of outputs are charged to the polluter, and a system of ecological tariffs (to allow countries to implement the first two proposals without putting themselves at a disadvantage).

11. **Earth Atmospheric Trust:** Most resource allocation today is through markets based on private property rights. But many assets are in the commons sector. "A proposed Earth Atmospheric Trust could help to massively reduce global carbon emissions while also reducing poverty" (p.265). This system would comprise a global cap-and-trade system for all greenhouse gas emissions, with resulting revenues deposited into the Trust, for enhancing and restoring the atmosphere.

12. **Reducing Inequality:** A large body of evidence shows that large income differences within countries are damaging, reducing social cohesion, restricting social mobility, increasing crime rates, and compromising poverty reduction. Inequality drives personal debt and consumerism, while more equal societies promote the common good and score higher on the Global Peace Index. Income differences can be reduced by taxes, benefits, reducing differences in pretax incomes, and promoting cooperatives and employee ownership. Dealing with tax havens for the rich is essential.

13. **A Proposed "MetaUniversity":** Our higher education system needs to adjust to a quickly changing world. A shift toward more interactive, problem-based courses in higher education is crucial. An international collaboration of universities could share online courses and teaching, which could "potentially move higher education to a new phase of development" (p.284). The MetaUniversity would facilitate production and maintenance of these courses, with peer review of all course content. The courses would be freely available to the public [e.g., the MOOC on "Planetary Boundaries" by Johan Rockström, sponsored by the UN Sustainable Development Solutions Network; www.unsdsn.org], but they could also be taken for credit with faculty involvement.

"A key problem, however, as stated at the outset of Chapter 4, is the "essential" need for a shared vision of sustainability, which has a variety of definitions."

14. **Information as a Global Public Good:** A vast literature describes the economic market's inability to efficiently produce and allocate information. Given the urgency of climate change and other critical problems that information can help solve, we should closely examine the effectiveness of markets, patents, and copyrights. Alternative institutions may be better equipped to manage the flow of information as a global public good, with publicly funded production and open access consumption. [NOTE: Ironically, consider the $99.95 list price for this important survey of ecological economics, which surely restricts usage!] A global research consortium would also be useful for determining appropriate technologies for energy, agriculture, chemistry, and global well-being in general, with new technologies "copylefted" (i.e., freely available for anyone to use).

15. **Strong Democracy:** "Solution of basic human needs requires a balance among social, built, human, and natural capital" (p.294). One institution that helps build social capital is strong democracy, where all citizens are free (and expected) to participate in all political decisions affecting the community. Good governance also requires Living Democracy (dispersed power, transparency, mutual accountability, cooperation, fairness, empathy), Deliberative Democracy (public deliberation of free and equal citizens, based on the belief that citizens need to be educated about issues that matter to them), and the six "Lisbon Principles" embodying the essential criteria for sustainable governance (responsibility, scale-matching, precaution, adaptive management, full-cost allocation, and participation).

In short, "we are in a race between educating ourselves about how the planet functions, and destroying it through acts of greed and hubris… Forging a new set of policies and tools capable of meeting these new challenges will require the new science of complex systems, the search for true economic sufficiency that acknowledges nature as an equal partner, and concern for fair and participatory democratic processes" (p.299). A path of sustainable development will also require a global social contract between North and South: the North should undertake to abandon mindless quantitative growth in favor of sustainable qualitative development, while the South should act to stabilize human populations and protect habitats for assuring species diversity. Making this transition "is the major challenge to humankind today" (p.299).

Now is the time of real choices: 1) attempting to continue business as usual; 2) attempting to achieve "green growth" as an environmentally sensitive version of BAU [see the Global Green Growth Initiative; www.gggi.org and the Green Growth Knowledge Platform, www.ggkp.org]; or 3) pursue a more radical departure of "sustainable human well-being" as the real goal—the only option for our finite planet.

COMMENT

A concise and well-documented integrative overview in time and space, backed up with a bibliography of some 650 references. A key problem, however, as stated at the outset of Chapter 4, is the "essential" need for a shared vision of sustainability, which has a variety of definitions. The authors make no effort to suggest how to attain a widely shared vision, let alone the equally daunting problem of "selling" this vision to policy-makers and citizens who elect them. They appear oblivious to the support for "Green Growth" by UNEP, OECD, and the World Bank, which, arguably, may be the only politically viable path for the near future. Once this relatively radical notion is accepted, the worthy goal of sustainable human well-being might then be seriously considered.

ALSO SEE a closely-related textbook, **Macroeconomics in Context** (Second Edition) by Neva Goodwin (Tufts University), Jonathan Harris (Tufts University), Julie A. Nelson (University of Massachusetts-Boston), Brian Roach (Tufts University), and Mariano Torras (Adelphi University). Armonk NY: M.E. Sharpe, Jan 2014, 441p, $59.95pb. This excellent overview of "contextual economics," written under the auspices of the Global Development and Environment Institute at Tufts (www.gdae.org/macro), describes the well-being goals of macroeconomics as improvement of living standards, stability and security, and financial, social, and ecological sustainability. Especially see Chapter 6 on alternative measures of well-being such as the Genuine Progress Indicator and the Better Life Index, and Chapter 18 on "Growth and Sustainability in the 21st Century," described as "crucially important in terms of economic education for intelligent citizenship." The authors have also published **Microeconomics in Context** (Third Edition) as a companion.

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