Locke Was Right: Nature Has Little Economic Value

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At the time Europeans began to colonize the New World, John Locke compared land values in Britain land in America.

> An acre of land that bears here twenty bushels of wheat, and another in America, which, with the same husbandry, would do the like, are, without doubt, of the same natural, intrinsic value. But yet the benefit mankind receives from one in a year is worth five pounds, and the other possibly not worth a penny . . . .[1]

Ecological economists today describe as "ecosystem services" or as "natural capital" what Locke called the "natural, intrinsic value" of land. In 1997, a group of ecological economists, in a famous survey, estimated the economic value of ecosystem services and related natural capital at between $16 and $54 trillion per year.[2] Locke suggested, on the contrary, that labor accounts for the economic value of agricultural and other production, while ecosystem services are "possibly not worth a penny."

Locke's Argument

Locke defended a labor theory of value. "Labour makes the far greatest part of the value of things we enjoy in this world: And the ground which produces the materials is scarce to be reckoned in, as any, as any, or at most, but a very small part of it."[3] Locke observed that land that is not improved by labor and technology yields almost nothing of use to us. To depend on nature's free largess, i.e., to hunt and to gather, Locke correctly surmised, is to starve. "Land which is wholly left to Nature, that hath no

improvement of Pasturage, Tillage, or Planting, is called, as indeed it is, *waste*; and we shall find the benefit of it amount to little more than nothing."[4]

One may reply, however, that even if land will not feed us without the use of labor and technology, labor and technology will not feed us without the use of land. Classical economists from Ricardo to Marshall therefore identified land, labor, and technology (or capital) as the three factors necessary for economic production. If natural resources, labor, and technology are all equally necessary inputs to production, why attribute economic value only to labor, as Locke did, or to labor and capital alone?

The reason is that labor and capital possess a crucial quality, namely, scarcity in relation to demand, which land lacks. Locke pointed out that excellent cropland was free for the taking in many places in the world, such as in regions of Spain (at the time) and in the "inland vacant places of America."[5] Locke wrote one cannot acquire land in America "to the prejudice of his neighbour, who would still have room for as good and as large a possession (after the other had taken out his) as before it was appropriated."[6] As if to vindicate Locke's view of the overabundance and thus the negligible economic value of cropland, the U.S. government starting in 1863 under the Homestead Act gave a quarter-section (160 acres) free to anyone who would farm it for five years. By 1900, about 600,000 farmers had received free title to about 80 million acres of land under the act.

According to Locke, if the price of fertile land is negligible, as it was in America, the economic value of food "must all be charged on the account of labour, and received as an effect of that."[7] Locke reasoned that of the benefits we associate with agricultural commodities, "nine-tenths are the effects of labour. Nay, if we . . . cast up the several expenses about them . . . we shall find that in most of them ninety-nine hundredths are

wholly to be put on the account of labour."[8] In the production of commodities, "Nature and the earth furnished only the almost worthless materials as in themselves."[9]

The economics of agriculture have changed little since Locke's time. "The cost of labor is the biggest part of the total food marketing bill," the USDA has reported year after year.[10] According to a 2004 USDA publication, "Nineteen cents of every dollar spent on U.S.-grown food goes to the farmer for the raw food inputs, while the other 81 cents covers the cost of transforming these inputs into food products. . . ."[11] Of the 19 cents, land – the rent on the natural resource – represents perhaps one or two pennies.

In 2004, a typical acre of fertile soil in the American heartland sold at the average price of $1,780, at least a quarter of which can be attributed to the distorting effect of subsidies, according to USDA figures.[12] Farmers who are paid not to plant crops as a way to control surplus bid up the price of land where they can not grow them. In the absence of these distortions, the prices of (or rentals for) agricultural land in the United States would constitute about one-tenth of the farmer's expenses and thus less than two percent of the price of food. This is consistent with Locke's calculation that only one part in a hundred of the prices of agricultural products can be credited to the natural properties of the land, while 99 percent must be credited to labor and the tools it applies.

In his recent book, *The Curse of American Agricultural Abundance* (2003), Willard Cochrane, a leading agricultural economist, argues that the government should stop paying tens of billions in subsides every year to prop up cropland prices. If President Bush succeeds in cutting payments, land will revert to prairie in the American West much as it has returned to forest in the East.[13] Cochrane suggests that "large parts of the Great Plains should be converted into a fenceless 'buffalo commons.'"[14] In the

absence of government subsidies, a lot of farmland in the United States will return to the natural condition and to the negligible economic value it had in Locke's time. Locke was right. Because of its abundance relative to demand, cropland furnishes only "almost worthless materials as in themselves" which can be obtained for almost nothing.

"Sell Your Land and Caddie"

Every real estate broker can recite the three factors that control the economic value of land: location, location, and location. In 1840, Johann Von Thuenen showed that land values – or the "rents" farmers can extract from they land they farm -- are higher the closer the land is located to city markets even if the uses of the land are the same.[15] Transportation costs will diminish the economic value of land, however fertile, that is far away. Nothing has changed in 250 years since Von Thuenen wrote. The economic value of land still depends almost entirely on its location, that is, on its distance to highways, schools, restaurants, theaters, and society generally – its proximity to the amenity of urban living as opposed to what Karl Marx called the idiocy of rural life.[16]

Today, an acre of farmland commands the very highest price if it can be taken out of row crops and planted instead to shopping malls and tract mansions. According to the USDA, "survey data indicated that agricultural land with a potential for immediate development (expected land use if sold) was valued at more than $5,700 per acre."[17] To rent a ten-by-four foot parking space in Manhattan, New York, you must pay far more than you would pay to rent a hundred acres of good farmland near Manhattan, Kansas.[18] Economic returns to nature from agriculture are negligible, just as Locke thought.

"Truly *sustainable* agriculture in America's future," an agronomist has written, "will include only the very few forms of agriculture that are compatible with urban life,"

such as nurseries and turf farms.[19] In 1928, humorist Will Rogers identified the only feasible strategy for sustainable agriculture in the United States. "I tell you turning your land into a golf course is the salvation of the farmer," he said. "The only thing to do with land now is just to play golf on it. Sell your land and caddie."[20]

The Lauderdale Paradox

In 1819, James Maitland, Lord Lauderdale, reasoned that any good that nature provides plentifully and freely, no one has any reason to purchase. It cannot fetch a price in a competitive market, even where markets for it exist, and so has no economic value. The result is a paradox. The more freely and lavishly nature benefits us, the less economic value it will possess.[21]

Manna from Heaven illustrates Lauderdale's paradox. According to Scripture, enough manna fell from Heaven during the Exodus to provide the Israelites with plenty of bread. Accordingly, no one had a reason gather or hoard more than he or she could consume. The Israelites, the Bible tells us, stored up manna to eat on the Sabbath since none fell on that day. Since everyone could easily acquire as much as he wished without charge, no one was willing to pay for it; accordingly, manna had no economic value except, perhaps on the Sabbath when it did not fall from Heaven (Exodus 16: 23-26).

The principal condition for production, exchange, and therefore economic value, Lauderdale argued, is scarcity. He defended two principles:

1. That things [with desirable qualities] are alone valuable in consequence of . . . existing in a certain degree of scarcity.

2. That the degree of value which every commodity possesses, depends upon the proportion betwixt the quantity of it and the demand for it.[22]

For Lauderdale, the economic value of a good can be located at the intersection of supply and demand for the next or incremental unit of that good, in other words, at its price in a competitive market. Economic theory suggests that competition drives consumer prices down to producer costs. Goods which cost the least to produce – such as the oxygen in the air – will fetch the lowest prices and therefore possess the least economic value, especially if supply vastly exceeds demand. That you inhaled a lot of oxygen yesterday does not make the air you breathe any less beneficial today. As long as the air is abundant and free, however, it has no economic value; that it is beneficial is irrelevant.

Advances in technology, by driving down the production costs of a good, lower its competitive market price and thus its economic value. The consumer pays less for his or her next purchase but may obtain the same benefit. For example, the long distance phone call that cost ten dollars years ago hardly costs ten cents today. Phone calls may soon be free – the Internet may allow this – and thus have no economic value. The benefit – the emotional, sentimental, and moral satisfaction of the ritual Sunday call to your mother-in-law – remains the same. The economic value of a good falls with its price even though the benefit does not decline. When the antibiotic Cipro lost its patent, for example, generic equivalents appeared at a tenth of the price. The "next" or "incremental" prescription costs the consumer much less but conveys exactly the same benefit.

Today the music industry is full of fear and loathing because potential consumers are ripping and burning songs for free for which they paid big bucks a few years ago. The entire industry, once worth billions, may lose its economic value because no one will buy what he or she can acquire *gratis*. People enjoy the music – now on their iPods -- as much as before, but they use the money that they once spent on recordings to purchase

other things. The price the music commands is zero; so is its economic value; but the benefit is as great as ever. The music industry, of course, cannot stay in business if its product cannot fetch a price – if everyone gets as much as he or she wants for free. Nature in contrast can benefit everyone freely without worrying about the prices people pay. It has no operating costs.

The Supply of Fresh Water

Consider a scenario in which Heaven rains manna in huge quantities but does not distribute it in equal amounts everywhere. The price of manna would vary with its distance from the deposits. This is consistent with the Von Thuenen model in which location is everything. What has value – what is scarce relative to demand – is not the manna, which is superabundant, but either 1) residential real estate close to the sources of manna or 2) the labor and technology needed to transport manna to where it is consumed.

Fresh water is a resource that nature provides through the hydrological cycle in vaster quantities than humanity can possibly use. The sun evaporates water from the oceans, the wind moves the clouds to land, and the distilled water precipitates like manna over the earth, but in some places more than in others. Overall, humanity uses about 2,100 km^3 of fresh water a year -- one-fiftieth of the amount that precipitates over land. The runoff from rain that is accessible – rainwater that is collected behind dams or in lakes, rivers, or aquifers near large human populations – equals slightly more than one-tenth of the total rainfall on land or 12,500 km^3 annually. This provides about 5,700 liters of water per day for every person on earth -- 10 times as much water as the average European uses and about three times as much as the average American consumes.[23]

For the residents of New York City, like those of many other municipalities, abundant, pure, clean rain water falls like manna from Heaven; it has no economic value. City residents must pay, however, for expensive dams, reservoirs, pipes, and tunnels to gather and deliver the water from upstate sources, primarily the Catskills watershed. Ecosystem services contribute nothing of economic value. People who live in the watershed are required to build septic systems to treat their sewage because nature will not do this for them. The City must deal with the fecal wastes produced by 350 vertebrate species that thrive in Catskill region, including huge populations of deer, beaver, and waterfowl. In the reservoirs, "the background contamination from wildlife populations is apparent."[24] Since the 1920s, New York City (like many municipalities) has chlorinated its water in part to kill fecal bacteria and other pathogens associated with natural habitat.

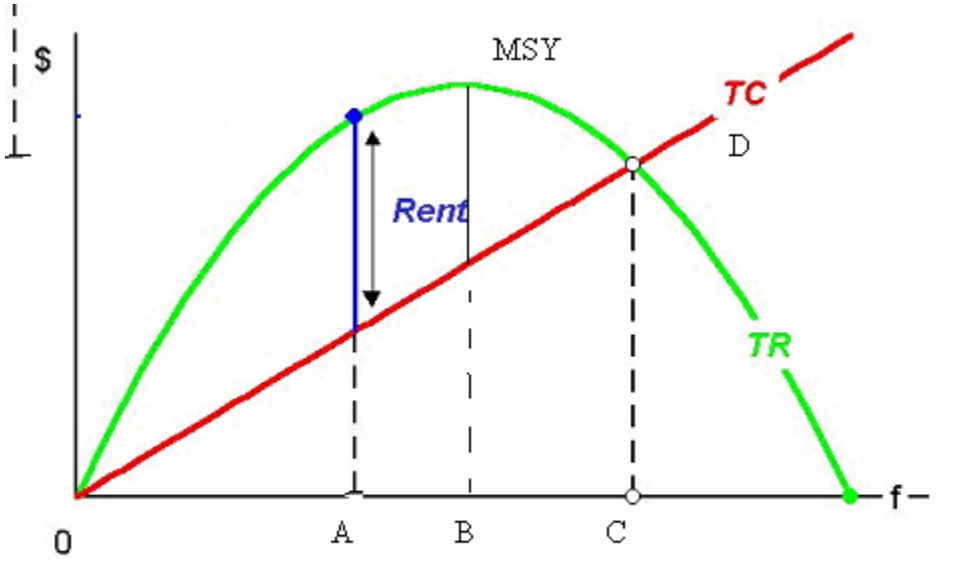
In search of a salient example of an ecosystem service that can command a market price, environmentalists often repeat the urban legend that New York City in the late 1990s invested between $1 billion and $1.5 billion to purchase wildlife habitat as a way to cleanse rain water.[25] There is no basis for the belief that New York City spent $1 billion or more to protect wildlife habitat as a way to purify its water supply.[26] This legend is constantly cited and repeated, however, perhaps because no better example can be found to illustrate an ecosystem service that commands a competitive market price.

Fish

What about fish captured in the wild? Wild fish stocks provide what may seem to be an obvious example of the economic value of natural processes or ecosystems. Economists use the concept of resource rent, developed by Ricardo in 1817, to measure this value. The rent on a natural resource is the amount left over when the costs of

exploiting a resource are deducted from the revenues it brings. In theory, the resource rent approximates the maximum the owner of the resource could charge for its use.[27]

To estimate the resource rent of wild populations of diverse kinds of fish, resource economists typically begin with a model that relates the total costs (TC) of exploiting the resource, including a normal return on investment, to the total revenue (TR) computed as the dockside price of fish per pound times the number of pounds of fish caught.[28]



. In this model, the difference between TC and TR represents the economic value or rent on the resource. It need not peak at the maximum sustained yield (MSY). When the fishing industry attains its most profitable levels of effort (point *A* of effort line *f*), new boats will be attracted to the resource, quickly moving the industry through MSY and to the point *C* on the effort line. At this "open access equilibrium point," TC coincides with TR and resource rents are dissipated. Governmental financial transfers to the fishing industry (subsidies) push the fishing effort even beyond the open access equilibrium and thus boost the total costs of fishing further out to point D, where they are today.

Fisheries experts often lament that "the main problem is that in the process of the expansion of fishing effort, resource rent has been completely dissipated. It has gone to finance the overexpansion of the fishery."[29] At fault are subsides paid by many nations to support their fishing fleets in competition with the fleets of other nations. In 1999, a representative year, OECD countries alone paid about $6 billion to subsidize their commercial fishing fleets. Some nations, such as Finland, paid more far in subsidies than the fish it sold brought in revenues; other countries, such as the United States, paid subsidies in excess of 25 percent of the total revenues.[30] Under these distorted conditions, capture fishing operates at a deficit supported by taxpayers. Potential resource rents are more than dissipated; the natural capital or ecosystem service realizes an economic loss.[31]

Even if the capture fishing industry optimized its effort, whatever resource rent it earned would be ephemeral. Capture fisheries must compete with aquaculture which offers lower costs, reliable year-round supplies at huge volumes, uniform and consistent quality, just-in-time delivery, traceability, proximity to markets, and virtually every other competitive advantage imaginable. "By the year 2030," according to the Food and Agriculture Organization, "aquaculture will dominate fish supplies and less than half of the fish consumed is likely to originate in capture fisheries."[32] Aquaculture accounts for over a third of the fish humans consume, and over the next two decades, according to the *Washington Post*, fish farming will largely "replace the last commercial food-gathering system based on hunting wild animals."[33]

Consider, for example, the price of fresh salmon, which has plummeted by about two-thirds since the early 1980s because of aquaculture. Salmon farming produces over a million metric tonnes annually, surpassing capture fisheries. According to a SeaWeb

study, "As markets for salmon become glutted and prices continue to decline, many multinational corporations involved in aquaculture are diversifying their operations by adapting methods of farming salmon to other species of carnivorous fish."[34] Fish prices should descend to those of chicken and turkey, which also consume fishmeal, or fall even lower as genetic engineering makes it easier to convert cheap organic matter along with soy and other oilseeds into high-protein feed.

The future of the fish industry lies with transgenic fish engineered for rapid growth, disease-resistance, inexpensive feeds, and table appeal.[35] We can expect over the next few decades a rapid decline in capture fishing as the large fleets of the past are replaced by intensive, biotechnology-based, vertically integrated, closed-system, highly capitalized industrial aquaculture controlled – as the hog and poultry industries are controlled – by a few multinational corporations. It is hard to see how capture fisheries, already subsidy-dependent, can survive competition from aquaculture except in special cases. When ecosystem services and wild stocks are inexpensive and superabundant, the economic return to nature is negligible. When they are not, technology quickly develops to capture economic rent by making cheap and abundant resource flows, such as genetic information and plentiful organic matter, do the work of more expensive ones.

The Great Transition

The transition from hunting and gathering in the wild to plantation-based industry, expected to occur in fisheries over the next two decades, has largely taken place in forestry. According to a recent report in *Issues in Science and Technology*, "The United States today finds itself in a world of timber surpluses and increasing competition," Industrial tree plantations are rapidly underpricing and outproducing wild forests. "Par-

ticularly important has been the expanded use of intensively cultivated, short-rotation tree plantations in temperate and subtropical regions of the Southern Hemisphere. These 'fiber farms' have proved to be extraordinarily productive."[36]

According to Roger Sedjo, a prominent expert, "High-yield plantation forestry has the potential to meet the world's industrial wood needs while simultaneously protecting existing natural forests and thereby conserving their environmental values."[37] The premium paid for large logs from slow-growth forests has largely disappeared because advanced methods can fuse small pieces of wood together for structural uses. Transgenic trees, moreover, will offer the same kinds of economic advantages – fast growth, cold-hardiness, uniform and predictable quality, disease resistance, etc. -- as transgenic fish.

The transition we are seeing from capture fishing and forestry to aquaculture and silviculture is unsurprising. An ecosystem service or resource flow that becomes scarce relative to effective demand also becomes economically valuable. For example, in the early nineteenth century, the price of whale oil, the principal source of illumination at the time, dramatically increased as the demand for lighting rose and the supply of whales decreased. For a short time, a living natural resource possessed an economic value and whaling produced great wealth.

In response to rising prices, however, technologists quickly substituted a more plentiful resource, first natural gas and then electricity, to produce the same good, illumination, as whale oil. With this substitution between resource flows came far greater efficiencies – a compact fluorescent light bulb in use today produces the more light with a tiny fraction of the energy used by Edison's bulbs, which were themselves far more efficient than earlier gas or oil lamps.[38]

Environmental economists such as John Krutilla have noted that so far advancing technology has "compensated quite adequately for the depletion of the higher quality natural resource stocks."[39] Krutilla observed that "the traditional concerns of conservation economics—the husbanding of natural resource stocks for the use of future generations—may now be outmoded by advances in technology."[40] Robert Solow has opined that "what little evidence there is suggests there is quite a lot of substitutability . . . ." Solow, a Nobel laureate, wrote that "[h]igher and rising prices of exhaustible resources lead competing producers to substitute other materials that are more plentiful and therefore cheaper."[41] During the 1950s and 60s, economists developed a model of economic growth that contained two factors: capital (including technology) and the labor to apply it.[42] This model differed from earlier ones because "resources, the third member of the classical triad, have generally been dropped."[43]

To argue that ecosystem services and with them natural capital have little or no economic value, as this talk has done, is to take seriously the examples of whaling in the nineteenth century and of the fishing and forestry industries today. Because whales have little or no economic value – no one needs whale oil anymore – they can be valued for their own sakes as the magnificent nearly sacred creatures they are.[44] Aquaculture and silviculture, by making wild fisheries and forests obsolete, allow society to regard wild fish and heirloom forests as aesthetic treasures and as ethical responsibilities, in other words, to appreciate and respect the aesthetic and spiritual values nature does possess.

Objections

To suggest that Nature has only a negligible economic value is to invite many objections. First, one may earnestly assert that ecosystems "act to purify air and water,

regulate the climate and recycle nutrients and wastes. Without these and many other ecosystem goods and services, life as we know it would not be possible."[45] The team that pegged nature's services at tens of trillions wrote, "The services of ecological systems and the natural capital stocks that produce them are critical to the functioning of the Earth's life-support system."[46] Bromides such as these, however edifying, tell us nothing about economic value, which is a measure of scarcity not dependency.

Second, one may ask whether society can justify expensive regulations to control pollution without ascribing economic value to ecosystems services. If you shoot someone, the bullet may disturb air currents that regulate the climate. Exactly the same analysis applies to shooting poisons through the water or air. Pollution represents a problem not of preserving ecosystem services but of protecting human safety, health, and property. Pollution represents coercion, trespass, or assault; it is a moral wrong we must minimize for ethical reasons not an external cost we should optimize for economic ones. If pollution damages property, for example, fish stocks, it should be enjoined as a nuisance. The regulation of pollution vindicates common law rights of person and property; the economic analysis of costs and benefits is largely beside the point.[47]

Third, what about "non-use" value? By now, a hundred commentators have pointed out that the economic literature on "non-use" or "existence" value confuses political beliefs with personal benefits. Responses to policy questions, in other words, are misconstrued as indicators of personal welfare. For "existence" or "non-use" values to be considered economic values, as economist Paul Milgrom has argued, they must reflect only "personal economic motives and not altruistic motives, or sense of duty, or moral obligation," or disinterested policy positions, as they often do.[48] Economists

expect their reasoned beliefs about public policy to be judged on the merits not priced at the margin. It is disrespectful, indeed maddening, for economists to offer to "price" by the method of "contingent valuation" the policy opinions and beliefs of others.

Fourth, natural amenities, such as the beauty and serenity of scenic vistas and open spaces, plainly possess economic value. Location is everything, however, at least as much with respect to beautiful places as fertile cropland. It can cost so much to travel to a magnificent vista, for example, a landscape in the Belgian Congo and or in Amazonia, that visitors may not be willing to pay much more as an admission fee, as it were, for the resource itself. Economists point out that people who live close to a beautiful place pay less in travel costs than visitors from farther away; this difference in travel costs can be construed as a "consumer surplus" for those nearby and thus as a potential resource rent.[49] However, housing and other goods may cost more the nearer they are to the resource – to a beach, for example – so that people who live relatively closer already pay premiums that exhaust the potential surplus or putative resource rent.

One might argue that differences in housing costs – rents are higher for places nearer the beach -- reflect the value of the natural resource. If access to the beautiful place is open, however, the resource rent will be dissipated as more and more houses are built, just as additional fishing boats dissipate the rent on a fishery. Another problem is that the scenic resource in question is economically valuable because of its location, that is, because it is near the houses. Since location is a symmetrical relation – A is near B if and only if B is near A – it may be arbitrary whether one says that houses are valuable because they are close to the beach or the beach is valuable because it is

close to the houses. It is a baffling question whether the economic value of location attaches to the houses or the beach – or how the rent should be divided between them.

Fifth, nothing has been said here about minerals, such as diamonds and gold, which are obviously scarce relative to demand, and thus have significant economic value. The argument here would not apply to diamonds and other minerals created with the earth but to goods such as fresh water, associated with the functioning of today's ecosystems.

Finally, one may object that the argument presented here rests upon a questionable conception of economic value, namely, exchange value, competitive market price, or the intersection of supply and demand. Given this definition it is obvious that manna had no economic value even when it constituted the life support system of the Israelites. Ecosystem services and associated natural capital possess little or no economic value only insofar as "economic value" refers to market pricing based on supply and demand.

What other conception of economic value, however, makes sense? As long as one defines economic value in terms of competitive market price, one can determine empirically the value of ordinary consumer goods. If one defines and defends a conception of economic value that does not refer to the intersection of supply and demand, one must then explain how to measure the economic value of ordinary products such as toothbrushes, pairs of shoes, and light bulbs, and services such as dental care and trash removal. To do this, one could ask how much people might pay for shoes or dental care if these goods became scarce – and thus try to tease out scarcity rents or demand prices for them. After paying scarcity or monopoly prices for basic consumer goods would anyone would have any income left to pay for the functioning of the Earth's life-support system?

Everyone agrees, of course, with platitudes about life-support systems and about how dependent we are on natural capital and ecosystem services. Locke, like the classical economists who followed him, such as Adam Smith, understood economic value as a measure of scarcity not dependency. Locke recognized that nature often provides services so plentifully that they have no economic value no matter how essential and beneficial they may be. From the perspective of economic value, Locke was right. "Nature and the earth furnished only the almost worthless materials as in themselves."

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[1] John Locke, Concerning Civil Government, Second Essay: An Essay Concerning The True Original Extent And End Of Civil Government V, 43 (1690): http://www.mind-trek.com/treatise/jl-ccg/jl-ccg05.htm

[2] Robert Costanza, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert O'Neill, Jose Paruelo, Robert Raskin, Paul Sutton and Marjan van den Belt, "The value of the World's Ecosystem Services and Natural Capital," *Nature* 387 (May 15,1987), pp.253-260.

[3] John Locke, Second Treatise Concerning Civil Government, V, 42.

[4] Locke, V, 42.

[5] Locke, V, 35.

[6] Locke, V, 35.

[7] Locke, V, 43.

[8] Locke, V, 40.

[9] Locke, V, 43.

[10] See USDA Factbook, "Cost of Food Services and Distribution," p. 8; available on line at: http://www.usda.gov/news/pubs/factbook/001b.pdf. The same statement is repeated in earlier years.

[11] USDA, *Amber Waves*, February 2004; on line at: http://www.ers.usda.gov/amberwaves/february04/indicators/behinddata.htm

[12] "Cropland values averaged $1,780 per acre and pasture values averaged $644 per acre on January 1, 2004, compared with $1,660 and $605 per acre, respectively, a year earlier," nationally. USDA Press Release, August 6, 2004. Available online at: http://www.nass.usda.gov/mt/pressrls/misc/lndvalue.htm. See also USDA, "Government Payments to Farmers Contribute to Rising Land Values," *Agricultural Outlook*/June-July 2001, stating, "The gap between land value with and without government payments . . . rose to 25 percent during 1998-2001. . . . For example, elimination of government payments would have lowered land values by 69 percent in parts of the Northern Plains, and by about 30 percent throughout much of the Corn Belt." On line at: http://www.ers.usda.gov/publications/agoutlook/june2001/AO282h.pdf

[13] See Bill McKibben, "An Explosion of Green," Atlantic Magazine, April 1995; on line at: http://www.theatlantic.com/politics/environ/green.htm

[14] Willard W. Cochrane, *The Curse of American Agricultural Abundance* (Lincoln: University of Nebraska Press, 2002), p. 122; endorsing the position of Deborah E. Popper and Frank Popper, "The Great Plains: From Dust to Dust," *Planning*, December 1987, pp. 12-18.

[15] J. H. von Thuenen, *The Isolated State* (New York: Pergamon, 1966 [1840]). Commentators write that von Thuenen considered "rent as a function solely of location, not fertility or climate, . . . with rent differentials arising from transportation costs." G. Cornelis van Kooten and Erwin H. Bulte, *The Economics of Nature* (Malden, MA: Blackwell, 2000), p. 61.

[16] In paragraph 28 of the Communist Manifesto, Marx uses the word "Idiotismus" which does not necessarily refer to idiocy ("Idiotie"). There is a lot of controversy over the correct translation.

[17] Press Release August 6, 2004; http://www.nass.usda.gov/mt/pressrls/misc/lndvalue.htm

[18] The Conservation Reserve Program in Kansas pays an average annual rental fee of about $36 per acre to farmers to retire their land from production – or about $10 per day per year for 100 acres. Try to find a reasonably located parking space in

Manhattan, NY for that price. For information, see: http://www.ks.nrcs.usda.gov/news/annual_rpt02/crp.html

[19] Steven C. Blank, *The End of Agriculture in the American Portfolio* (Westport, CT: Quorum Boos), p. 125.

[20] Quoted by Steven C. Blank, *The End of Agriculture in the American Portfolio* (Westport, CT: Quorum Books), p. 125.

[21] For citations to and discussion of Maitland, see Herman E. Daly, "The Return of Lauderdale's Paradox," *Ecological Economics* 25 (1998) 21–23, citing Lord Lauderdale, "An Inquiry into the Nature and Origin of Public Wealth and into the Means and Causes of its Increase," 2nd edn. Constable, Edinburgh, 1819.

[22] James Maitland, Lord Lauderdale, "An Inquiry . . ." available on line: http://www.thoemmes.com/economics/wealth5.htm

[23] For discussion and citations, see Bjorn Lomberg, The Skeptical Environmentalist (New York: Cambridge University Press 1998), p. 150.

[24] Committee to Review the New York City Watershed Management Strategy, National Research Council [NRC], *Watershed Management for Potable Water Supply: Assessing the New York City Strategy* (Washington, DC: National Academy Press), p. 161; available online at: <http://www.nap.edu/catalog/9677.html?se_side>. Increases in fecal coliform bacteria, when observed in the principal reservoir, "coincided both spatially and temporally" with increases in waterfowl populations (p. 197; cf., p. 160.

[25] For examples, see Graciela Chichilnisky and Geoffrey Heal, "Economic Returns from the Biosphere," *Nature* 391(February 1998): 629-630; Simon Levin, *Fragile Dominion* (Reading, MA: Perseus Books, 1999), p. 204; Levin, *Fragile Dominion*, p. 204; Edward O. Wilson, "What Is Nature Worth," *Wilson Quarterly*, Winter 26(1)(2002): 20-39 at 23-24; National Science Board, *Task Force on the Environment, Environmental Science and Engineering for the 21st Century: The Role of the National Science Foundation* available online at: http://www.nsf.gov/cgi-bin/getpub?nsb0022 and http://www.nsf.gov/nsb/tfe/nsb99133/box1.htm>; Robert B. Jackson, Stephen R. Carpenter, Clifford N. Dahm, Diane M. McKnight, et al., "Water in a Changing World," published on line by the Ecological Society of America, Issues in Ecology, <http://www.esa.org/issues9.htm> and reprinted in *Ecological Applications* August 11, 2001: 1027-1045.

[26] For discussion, see Mark Sagoff, *Price, Principle, and the Environment* (New York: Cambridge University Press, 2004), Chapter 6, esp. pp. 128-137.

[27] The resource rent "reflects what fishermen are willing to pay to harvest that amount of the fish stock. Resource rent is the net revenue in excess of normal profits generated

by the harvesting of fish that is due to the fish stock itself. In open-access fisheries, rent dissipation is said to occur because the value of the fish stock is not captured." http://www.st.nmfs.gov/st1/econ/oleo/chap1.pdf

[28] This is generally known as a Schaefer model after M. B. Schaefer, "Some aspects of the dynamics of populations important to the management of commercial marine fisheries," Bulletin of the Inter-American Tropical Tuna Commission 1 (1954): 25-56.

[29] "Environmental Fiscal Reform for Sustainable Development and Poverty Reduction Workshop Proceedings and Country Case Studies," Information Sheet 2: Fiscal Issues in Fisheries Exploitation and Management , p. 52 (Eschborn: Bonn, Germany, 2004); available on line at: http://www2.gtz.de/rioplus/download/efr_compilation-part1-e.pdf

[30] Subsidies in the OECD Fisheries Sector: A Review of recent Analysis and Future Directions, 2002. By A. Cox and C.-C. Schmidt, commissioned by the OECD. See page 7 and table on page 10.

[31] Overall, in 2000, capture fisheries production world-wide, according to the Food and Agriculture Organization, "reached 94.8 million tonnes, the highest level ever. The estimated first sale value of this production amounted to some US$81 billion." How much of this could be realized under optimal conditions and attributed to ecosystems is anyone's guess. If the fishing effort stopped at an economically optimal point, it would certainly capture some of this revenue resource rent attributable to ecosystem services. The potential rent would differ for different species at different places and times. See, *State of the World's Fisheries and Aquaculture 2002* (S0FIA) http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/005/y7300e/y7300e04.htm

[32] United Nations Food and Agriculture Organization (FAO), State of the World's Fisheries and Aquaculture (SOFIA) 2000, Part 4, "Outlook," on line at: http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/003/X8002E/x8002e07.htm

[33] Juliet Eilperin, "Fish Farming's Bounty Isn't Without Barbs; Aquaculture May Change Way U.S. Eats, but Effect on Seas Is a Concern," Washington Post, January 24, 2005, p. A1.

[34] SeaWeb, "What Price Farmed Fish" (2003); on line at: http://www.seaweb.org/resources/sac/pdf/ExecSum.pdf

[35] Pew Initiative on Food and Biotechnology, "Future Fish? Issues in Science and Regulation of Transgenic Fish," Pew Initiative on Food and Biotechnology, 1331 H Street, Suite 900, Washington, DC 20009 USA. January 2003. 72p. http://pewagbiotech.org/research/fish/fish.pdf

[36] Jerry F. Franklin and K. Norman Johnson, "Forests Face New Threat: Global Market Changes," *Issues in Science and Technology*, Summer 2003, online at:

http://www.issues.org/issues/20.4/franklin.html

[37] Roger A. Sedjo, "Transgenic Trees: Implementation and Outcomes of the Plant Protection Act," Resources for the Future Discussion Paper 04-10 (April 2004); p. 4; online at http://www.rff.org/Documents/RFF-DP-04-10.pdf. See also, Sedjo, R.A., and D. Botkin. 1997. Using forest plantations to spare natural forests. *Environment* 30: 15–20, 30. Victor, D., and J. Ausubel. 2000. Restoring the forests. *Foreign Affairs* November-December.

[38] Compact fluorescent lights are five times more efficient than today's incandescent bulbs and last eight times longer. The progress from candles to carbon filament to tungsten incandescent lamps, for example, halved several times over the fuel required for a given unit of household lighting. See Dennis Anderson, "Energy-Efficiency and the Economics of Pollution Abatement," *Annual Review of Energy and the Environment* 18(1993): 291-318; Amory B. Lovins, "Four Revolutions in Electric Efficiency," *Contemporary Policy Issues* 8(1990): 122-141, esp. p. 126.

[39] John V. Krutilla, "Conservation Reconsidered," *American Economics Review* 57(1967): 777-96 ," quotation, p. 777.

[40] Ibid., 778.

[41] Robert M. Solow, "Is the End of the World at Hand?" *The Economic Growth of Controversy*, eds. Andrew Weintraub et al. I.A.S.P., (London: MacMillan, 1974): 39-53. Solow sought to establish that technological change, rather than the resource base, is essential to economic production. See, e.g., Robert M. Solow, "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics*, 70(1956) 60-84; Robert M. Solow, "Technical Change and the Aggregate Production Function**,"** *Review of Economics and Statistics*, 39(1957): 312-20.

[42] Solow argued that if the future is like the past, raw materials will continually become more plentiful. See Solow, "Is the End of the World at Hand," p. 49.

[43] Nordhaus and Tobin, "See., e.g., William D. Nordhaus and James Tobin, "Is Economic Growth Obsolete?" *Economic Growth* 5(1972), p. 14. See generally, William D. Nordhaus, *Invention, Growth, and Welfare: A Theoretical treatment of Technological Change* (Cambridge, MA: MIT Press, 1969). Many mainstream economists accept Solow's argument. As analyst Peter Drucker has written, "[w]here there is effective management, that is, application of knowledge to knowledge, we can always obtain the other resources." Peter Drucker, *Post Capitalist Society* (New York: HarperBusiness, 1993), p. 45. Others have argued that our technical ability to substitute resources for one another is so great that "the particular resources with which one starts increasingly become a matter of indifference. The reservation of particular resources for later use, therefore, may contribute little to the welfare of future generations." Harold J. Barnett and Chandler Morse, *Scarcity and Growth:*

The Economics of Natural Resource Availability (Baltimore: Resources for the Future, Johns Hopkins Press, 1963), p. 11.

[44] In this spirit, a group of Nobel laureates and others have circulated a petition declaring that "high-yield practices, based on advances in biology, ecology, chemistry, and technology, are critically needed in agriculture and forestry not only to achieve the goal of improving the human condition for all peoples but also the simultaneous preservation of the natural environment and its biodiversity through the conservation of wild areas and natural habitat." Norman Borlaug, Oscar Arias, and hundreds of others, "Declaration in Support of Protecting Nature with High-yield Farming and Forestry," Center for Global Food Issues, 2002; http://www.highyieldconservation.org/index.html.

[45] Douglas J. Krieger, "The Economic Value of Forest Ecosystem Services: A Review," The Wilderness Society, March 2001, p.iii; available on line at http://www.wilderness.org/Library/Documents/upload/Economic-Value-of-Forest-Ecosystem-Services-A-Review.pdf

[46] Costanza et al. "The Value of the World's Ecosystem Services and Natural Capital," p. 253.

[47] For an extended argument for this position, see Sagoff, *Price, Principle, and the Environment*, Chapter 5.

[48] Paul Milgrom, *Is Sympathy an Economic Value? Philosophy, Economics, and the Contingent Valuation Method, in Contingent Valuation: A Critical Assessment,* J.A. Hausman ed. (Elsevier: North Holland, 1993), p. 431.

[49] There are many good introductions to the "travel cost" method of "pricing" environmental amenities. See, for example, Eban S. Goodstein, *Economics and the Environment* (4th edition) (Hoboken, NJ: 2005), pp. 149-151. The idea is to figure out how much people would pay as an admission charge to the beach, scenic area, or whatever, once they have paid all the other associated costs, such as travel costs. People who live closer but who are otherwise like those who come from afar would pay the difference in travel costs, one could surmise, to use the resource. However, they may have to pay other costs, for example, to live closer. Once all associated costs are taken into account, an equilibrium may have been achieved, such that all transactions take place at the margin and there is no rent to be had. The assumption that such an equilibrium has been achieved seems at least as safe as the assumption that people who live near a resource realize in savings the difference between what they and others spend on travel costs to visit it.