

Natural Wealth

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1. Questions and Responses

Are humanity's dealings with nature sustainable? Can we expect world economic growth to continue in the foreseeable future? Should we be confident that knowledge and skills will increase in such ways as to lessen our reliance on nature in relation to humanity's growing numbers and rising economic activity?

Contemporary discussions on these questions are now several decades old. If they have remained alive and continue to be shrill, it is because two opposing empirical perspectives shape them. On the one hand, if we look at specific examples of what economists call natural capital, but what may be better called *natural wealth* (aquifers, ocean fisheries, tropical forests, river estuaries, the atmosphere as a carbon sink—*ecosystems*, generally), there is convincing evidence that at the rates at which we currently exploit them they are very likely to change character dramatically for the worse, with little advance notice. Indeed, as the Millennium Ecosystem Assessment has confirmed,¹ many ecosystems have already collapsed, with short notice. On the other hand, if we study historical trends in the prices of marketed resources (for example, minerals and ores), or improvements in life expectancy, or growth in recorded incomes in regions that are currently rich and in those that are on the way to becoming rich, resource scarcities wouldn't

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¹ Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being* (Washington, D.C.: Island Press, 2003); R. Hassan, R. Scholes, and N. Ash, eds., for Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being: Current State and Trends* (Washington, D.C.: Island Press, 2005).

appear to have bitten. Suppose you were to point to the troubled nations of sub-Saharan Africa and suggest that resource scarcities are acute there today. Those with the former perspective (ecologists generally) will tell you that it is because people in the world's poorest regions face acute resource scarcities relative to their numbers that they are so poor, while those with the latter perspective (economists usually) will inform you that people there experience serious resource scarcities because they are poor. When experts disagree over such a fundamental matter as the direction of causation, there is little to go on. I have friends among economists who believe natural capital is worth a very tiny fraction of the total wealth of nations, at best perhaps 2–3 percent, which is the share of national income in the United States going to agriculture. I shall presently explain why it is that Nature appears to be of negligible economic importance in national statistics and also why we should dismiss that finding.

Those conflicting intuitions between ecologists and economists are also not unrelated to an intellectual tension between the concerns people share about carbon emissions and acid rains that sweep across regions, nations, and continents, and about declines in the availability of firewood, fresh water, coastal resources, and forest products in as small a locality as a village in a poor country. That is why “environmental problems” present themselves in different ways to different people. Some identify environmental problems with population growth, while others identify them with wrong sorts of economic growth. There are those who identify environmental problems with urban pollution in emerging economies, while others view them through the spectacle of poverty. Each of those visions is correct. There isn't just one environmental problem. There is a large collection of them; and they manifest themselves at different spatial scales and operate at different speeds. In this reckoning, environmental pollutants are the reverse of natural resources. Roughly speaking “resources” are “goods” (many being sinks into which pollutants are discharged), while “pollutants” (the degrader of resources) are “bads.” Pollution is the other side of conservation. That is why pollution and conservation can be studied in a unified way.

Despite the conflicting intuitions, most economists would appear to be convinced that scientific and technological advances, the accumulation of reproducible capital (machinery, equipments, buildings, roads), growth in human capital (education, skills), and improvements

in the economy's institutions (norms and laws, which are themselves a form of capital assets) can overcome diminutions in natural capital. Otherwise it's hard to explain why twentieth-century economics has been so detached from the environmental sciences. Judging by the profession's writings, we economists see Nature, when we see it at all, as a backdrop from which resources and services can be drawn in isolation. Macroeconomic forecasts routinely exclude natural wealth. Accounting for Nature, if it comes into the calculus at all, is usually an afterthought to the real business of "doing economics." We economists have been so successful in this enterprise that if someone exclaims, "Economic growth!", no one needs to ask, "Growth in what?"—we all know they mean growth in gross domestic product (GDP).

The rogue word in GDP is "gross." Since GDP is the total value of the final goods and services an economy produces, it doesn't deduct the depreciation of capital that accompanies production—in particular, it doesn't deduct the depreciation of natural capital. In the quantitative models that appear in leading economics journals and textbooks, Nature is taken to be a fixed, indestructible factor of production. The problem with the assumption is that it is wrong: Nature consists of degradable resources. Agricultural land, forests, watersheds, fisheries, mangroves, coral reefs, fresh water sources, river estuaries, the atmosphere—ecosystems generally—are capital assets that are self-regenerative, but suffer from depletion or deterioration when they are overused. To assume away the physical depreciation of capital assets is to draw a wrong picture of future production and consumption possibilities that are open to a society.

Notice that to ignore depreciation is to assume that natural capital is of negligible worth. The reason economic statisticians get away with ignoring Nature is that for the most part market prices of natural capital are way below their social worth.

2. Property Rights to Natural Capital

Why don't market prices reflect Nature's scarcity value? If natural capital really is becoming scarcer, wouldn't their prices have risen, signaling that all is not well?

The problem is that if prices are to reflect the social scarcities of goods and services, markets must function well. However, for many types of natural capital—most especially ecological resources—

markets not only don't function well, often they don't even exist. In some cases they don't exist because relevant economic interactions take place over large distances, making the costs of negotiation too high (such as the effects of upland deforestation on downstream farming and fishing activities); in other cases they don't exist because the interactions are separated by large temporal distances (for example, the effect of carbon emission on climate in the distant future, in a world where forward markets don't exist because future generations are not present today to negotiate with us). Then there are cases (the atmosphere, aquifers, the open seas) where the migratory nature of the resource keeps markets from existing; they are called "open access resources," and they experience the tragedy of the commons.

Each of these examples points to a failure to have secure *property rights* to natural capital. We can state the problem in the following way: ill-specified or unprotected property rights prevent markets from forming or make markets function wrongly when they do form. By "property rights" I don't only mean private property rights, I include communal property rights (for example, over common property resources, such as woodlands, in South Asia and sub-Saharan Africa) and public property rights. At an extreme end are "global property rights," a concept that is implicit in current discussions on climate change. But the concept isn't new. That humanity has collective responsibility over the state of the world's oceans used to be explicit in the 1970s, when politicians claimed that the oceans are a "common heritage of mankind."

The failure to establish secure property rights to natural wealth typically means that the services natural capital offers us are underpriced in the market, which is another way of saying that the use of Nature's services is implicitly subsidized. At the global level what is the annual subsidy? One calculation suggested that it is 10 percent of annual global income. My reading is that the margin of error in that estimate is very large. But it's the only global estimate I have come across.

There are convincing estimates at the local level, though. Several studies have estimated the decline in forest cover in Indonesia and Malaysia, respectively. They found that when depreciation is included, national accounts look quite different: net domestic saving rates are some 20–30 percent lower than recorded saving rates.² More recently,

² R. Repetto, W. Magrath, M. Wells, C. Beer, and F. Rossini, *Wasting Assets: Natural Resources and the National Income Accounts* (Washington, D.C.: World

the Millennium Ecosystem Assessment published quantitative information that could be used to create more reliable estimates of Nature's subsidies.³ International organizations such as the World Bank have the resources to undertake that work, but they appear to have been reluctant to do so.

The widespread absence of well-defined or well-enforced property rights to natural capital means that transactions in them involve *non-market relationships*. That is why we are in particular need of a robust ethical framework when dealing with Nature. Mutual trust in our relationships with one another assumes enormous significance in the economics of Nature. This is a matter I shall come back to later.

Being underpriced, Nature is overexploited. So, an economy could enjoy growth in real gross domestic product (GDP) and improvements in the United Nations' Human Development Index (HDI) for a long spell even while its overall economic base shrinks. A great deal of my work has been directed at trying to bring Nature into economics in a seamless way. This has meant studying "small" problems (for example, people exploiting a fishery, a wetland, a coral reef, a water hole, a mangrove, a grazing field, a woodland, and so forth), and then aggregating those small problems so as to construct a macroeconomic picture of the many ways the fates of entire economies are shaped. From the global perspective, each of those innumerable small problems may indeed be "small." But when you add them up, the sum is not small. Recent empirical work on the matter suggests that they are often very large.⁴

3. *Wealth and Well-Being*

When it comes to macroeconomics, we are in the realm of *macroeconomic evaluation*. In evaluating an economy, however, there are five questions we can ask: (A) How is the economy doing? (B) How has it performed in recent years? (C) How is it likely to perform under "business as usual"? (D) How is it likely to perform under alternative policies? (E) What policies should be pursued there?

Resources Institute, 1989); J. R. Vincent, R. M. Ali, and Associates, *Environment and Development in a Resource-Rich Economy: Malaysia Under the New Economic Policy* (Cambridge, Mass.: Harvard Institute for International Development, 1997).

³ Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being* (2003).

⁴ P. Dasgupta, *Human Well-Being and the Natural Environment* (Oxford: Oxford University Press, 2001).

National income accounts offer information relevant for answering question (A), although as I have suggested earlier, they do so in an unsatisfactory way by studying GDP. In contrast to (A), *policy evaluation* (including *project evaluation*), is the way to answer questions (D) and (E). The idea is to evaluate an economy at a point in time before and after a hypothetical change (the policy change) has been made to it. In contrast, the literature on *sustainable development* answers questions (B) and (C) by evaluating economic change when the change is the passage of time itself.

In collaboration with my friends Kenneth Arrow and Karl-Goran Mäler, I have unearthed what to us was an unexpected analytical truth: *policy evaluation and sustainability analysis, although seemingly different exercises, require us to make use of the same economic object, namely, a comprehensive measure of wealth, corrected for population changes.*⁵ By wealth I mean the social worth of an economy's entire stock of capital assets, which is why we call it *comprehensive wealth*, to remind ourselves that the measure is to include all capital assets: (i) manufactured capital (building and machinery, roads and rail tracks); (ii) human capital (health and skills); (iii) knowledge; (iv) institutions (social norms and the rule of law), and (v) natural capital. Comprehensive wealth (henceforth, "wealth") is a number, expressed, say, in international dollars.

The theoretical finding I am alluding to is this: *human well-being across the generations increases if and only if wealth per capita increases.* The above statement is an analytical truth, and so, incontrovertible. Of course, wealth is not well-being; what the findings say is that although different, the two move in the same way. Studying movements in one (wealth) enables us to study movements in the other (well-being).

In estimating wealth, we are to multiply the stock of each kind of capital asset by its social worth and add those products. An asset's social scarcity value (or social worth) is called its *shadow price*, to contrast it from its market price, to which the shadow price may bear little relationship. Formally, *an asset's shadow price is the contribution an additional unit of it would make to human well-being.* (A

⁵ P. Dasgupta and K.-G. Mäler, "Net National Product, Wealth, and Social Well-Being," *Environment and Development Economics* 5, no. 1 (2000): 69–93; Dasgupta, *Human Well-Being and the Natural Environment*; K. J. Arrow, P. Dasgupta, and K.-G. Mäler, "The Genuine Savings Criterion and the Value of Population," *Economic Theory* 21, no. 2 (2003b): 217–225.

pollutant's shadow price would be negative.) By human well-being we mean not only the well-being of people today, but also of those who are yet to be born. So, in order to estimate an asset's shadow price we need two pieces of information: (a) a conception of intergenerational well-being, and (b) a reasoned forecast of the economy into the indefinite future. That means shadow prices depend both on "values" and "facts." Shadow prices form the bridge between human values and the factors that contribute to human well-being.⁶ There are cases where shadow prices can be approximated by market prices, but for most types of natural capital they differ greatly from market prices. Ecological economists have devised ingenious methods for estimating the shadow prices of particular natural assets, but there is a long way to go before we have a reasonably complete set of shadow prices with which to estimate the wealth of nations. A systematic assault on such estimation exercises should now be a priority among national and international economic organizations.

That said, we will never get shadow prices entirely "right." That's because both deep values (what value should we place on the blue whales?) and deep facts (what would be the consequences of an increase in global mean temperature by 3 degrees?) are involved. But that's not to say we may not be able to arrive at *ranges* of figures. For example, the shadow price of a forest in the uplands of a watershed would include, among other things, the contribution it makes to the economic profitability of farmers downstream (reducing water runoff and siltation). Studies by Pattanayak and Butry have arrived at crude estimates of the contribution Malaysian forests in the uplands make to downstream farmers' economic profits.⁷

We can now appreciate how it can be that an economy accumulates wealth in the form of manufactured capital, human capital, and knowledge, perhaps even improves the character of some of its institutions, but decumulates its natural capital to such an extent that its comprehensive wealth declines. But if natural capital doesn't enter national statistics, no one in the statistical office will notice that overall

⁶ We note in passing that consumption discount rates relate the shadow prices of current and future stocks of assets.

⁷ S. K. Pattanayak, "Valuing Watershed Services: Concepts and Empirics from Southeast Asia," *Agriculture, Ecosystems & Environment* 104, no. 1 (2004): 171–184; S. K. Pattanayak and D. T. Butry, "Spatial Complementarity of Forests and Farms: Accounting for Ecosystem Services," *American Journal of Agricultural Economics* 87, no. 4 (2005): 995–1008.

wealth has declined. They will record that GDP has increased. In the meantime, the economy will have been following an unsustainable development path. The accompanying table gives very crude estimates of movements in comprehensive wealth during the past three decades in the world's poorest countries. As the table shows, countries in South Asia grew in GDP per capita and showed improvements in the United Nations' Human Development Index. But they became less wealthy on a per capita basis. In each case the divergence between the two sets of statistics was traceable to declines in natural wealth. We should conclude that official statistics recording the progress of nations are misleading.

The Progress of Nations

	% annual growth rate 1970–2000					
	<i>I/Y</i> *	<i>population</i>	<i>TFP</i> †	<i>wealth</i> (<i>p.c.</i>)	<i>GDP</i> (<i>p.c.</i>)	Δ <i>HDI</i> **
Africa	-2.1	2.7	0.1	-2.8	-0.1	+
Bangladesh	7.1	2.2	0.7	-0.8	1.9	+
India	9.5	2.0	0.6	-0.4	3.0	+
Nepal	13.3	2.2	0.5	-0.4	1.9	+
Pakistan	8.8	2.7	0.4	-1.4	2.2	+
China	22.7	1.4	3.6	4.8	7.8	+

* Comprehensive investment as share of GDP (average over 1970–2000)

† Total factor productivity

** Change in HDI between 1970–2000

Adapted from P. Dasgupta, *Human Well-Being and the Natural Environment* (Oxford: Oxford University Press, 2001); and K. J. Arrow, P. Dasgupta, L. Goulder, G. Daily, P. R. Ehrlich, G. M. Heal, S. Levin, K.-G. Mäler, S. Schneider, D.A. Starrett, and B. Walker, "Are We Consuming Too Much?", *Journal of Economic Perspectives* 18, no. 1 (2004): 147–172.

Distortions in the pricing of primary factors of production filter down to influence research and development. The latter in turn influences the character of technological change. Because Nature's services are underpriced in the market, innovators have little reason to economize on their use. We shouldn't be surprised when new technologies are rapacious in the use of natural capital.

4. *Trust and Cooperation*

The pervasive failure of markets to mediate transactions in natural capital in an efficient and equitable way tells us that in our dealings with Nature, trust and cooperation assume deep significance. Our dealings with Nature inevitably involve non-market relationships. Sadly, several of the preconditions for cooperation would be found to be entirely missing in the international context. The debacle at Copenhagen was expected by many of us.⁸ Why?

Nations (by which, of course, I mean national leaders) differ greatly in their assessment of the losses and gains to them from continuing increases in carbon concentration: some nations are small, while others are large; some are rich, while others are poor; some are in the tropics, others in temperate zones; some are governed by leaders who take science seriously, others are less fortunate; and so on. Side payments would be needed if all nations were to sign a treaty, but the promise of such payments may not be credible. For a treaty to be believable, it must be self-enforcing, in the sense that it should be in the interest of each country to abide by the treaty if all others were to abide by it. Among the possible outcomes of international negotiations over climate change is the “null-treaty,” meaning global non-cooperation, commonly referred to as “business as usual.” Moreover, it can be that the negotiations harbor more than one self-enforcing treaty. Treaties would differ in their efficiency and in the distribution of benefits and burdens among nations. Barrett and Carraro have shown that not all countries should be expected to sign a potential treaty on climate change.⁹ Some (among them many small countries) would “free ride.” Among the choices to be made in designing a treaty are adaptation and mitigation measures. The costs and benefits involving the two kinds of investment would be expected to differ among countries. So, economists who study the political economy of climate change face the problem of having to explain which equilibrium would be selected. Factors

⁸ See P. Dasgupta, “Trust and Cooperation Among Economic Agents,” *Philosophical Transactions of the Royal Society B* 364 (2009): 3301–3309.

⁹ S. Barrett, *Environment and Statecraft: The Strategy of Environmental Treaty-Making* (New York: Oxford University Press, 2003); C. Carraro, “Climate Change Policy: Models, Controversies, and Strategies,” in *The International Yearbook of Environmental and Resource Economics 2002/2003*, ed. T. Tietenberg and H. Folmer (Cheltenham: Edward Elgar, 2002).

outside theoretical models would be particularly relevant here. The power of rich countries could be expected to tilt the selection toward their favor.

As the Kyoto Protocol didn't lay the groundwork for a self-enforcing treaty on climate change, we shouldn't be surprised that it has been a failure. On the other hand, the Montreal Protocol on the emission of chlorofluorocarbons (CFCs) has been a success. Why? It can be shown that if relative to the costs of curbing emissions, the perceived benefits are significant, agreement can be reached among large numbers of nations. In effect, very little in the way of side payments needs to be made in order for signatories to enjoy the benefits. This was the case with curbing CFCs. Carbon emissions are a problem of a different order of magnitude. The costs of controlling emissions to any significant degree are huge, while the benefits of controlling them are likely to be diffuse. Unlike radiation arriving through holes in the ozone layer, global climate change doesn't kill people in a direct, identifiable, and immediate way. It is easy to go into denial over climate change.

Although in discussions on global climate change it is frequently claimed that adaptation and mitigation are complementary activities, they are more like substitutes.¹⁰ As countries invest more in the former, they suffer less from climate change and find mitigation less attractive. But mitigation is a global public good ("windmills"), whereas adaptation is a national public good ("dikes"). One can imagine a situation where the globally optimal investment policy would have every country invest in windmills, but where non-cooperation would lead each nation to construct only dikes. Imagine that the ideal international treaty (with appropriate, credible side payments) sustains a high level of participation and requires so many windmills to be built that no one needs to build dikes. It can, nevertheless, be that the treaties that are eventually signed are ones under which rich countries construct dikes and pollute the atmosphere, leaving poor countries not so much high and dry, as "low and wet." Such an ominous possibility cannot yet be ruled out.

5. Decency and the Rule of Law

Many thinkers point to the primacy of the rule of law in economic development. The rule of law, however, is consistent with many forms

¹⁰ S. Barrett, "Dikes vs. Windmills: Climate Treaties and Adaptation," Discussion Paper, The Johns Hopkins University (2008).

of government and international political arrangements. It isn't only a political democracy in the Western mode that can be expected to protect and promote the rule of law. Practice of the rule of law, more generally, an expectation of decency in the public domain, creates trust among people, as they go about their daily lives. In this lecture I have tried to show why trust and cooperation are of the utmost importance in our dealings with Nature. That is why we economists should now work more closely with educators and philosophers in better understanding the social climates that promote the growth of pro-social disposition in us all. To be true to oneself is in all probability the surest route to being true to others. The mystery is how to enlarge the set of those "others" beyond one's neighbors. So, the economics of Nature leads us to the deepest question in the social sciences, which remains unanswered: How do grace and decency establish themselves among wide and disparate groups of people?

