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The New Economy of Nature

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When three-year-old Becky Furmann got the "poopies" and became dehydrated, her doctor urged her to drink water. He didn't know that water had caused the rare illness that would kill her. As the chubby blond child grew thin and pale, her sufferings were finally confirmed as the ravages of Cryptosporidium parvum, a parasite almost unheard of until April 1993, when it slipped through one of the two modern filtration plants in Milwaukee, Wisconsin, and entered the city's water supply. Becky had been born with human immunodeficiency virus (HIV), which weakened her immune system, yet she had seemed otherwise healthy until then. Cryptosporidiosis sealed her fate.

In all, Milwaukee's cryptosporidiosis epidemic led to more than one hundred deaths and four hundred thousand illnesses. The victims had been betrayed by their water—and by their faith in the technology keeping it safe. What's more, they had plenty of company throughout the world.

At the end of the twentieth century, more than three million people were dying every year of diseases spread by water, and another one billion were at risk, lacking access to water suitable to drink. As Milwaukee's disaster showed, the problem wasn't limited to developing countries. Some thirty-six million Americans were drinking water from systems violating Environmental Protection Agency standards. One million Americans were getting sick every year from the contamination, and as many as nine hundred were dying from it. And, as happened in Milwaukee, sometimes the highest-technology methods couldn't keep the contaminants out. Breakdowns were becoming a serious problem as the mechanical systems aged and many strapped local governments deferred maintenance, to the point that the American Water Works Association estimated it would cost $325 billion to rehabilitate the country's dilapidated mechanical systems to ensure safe drinking water for everyone.

This crisis, and particularly this specter of expense, led the city of New York in 1997 to embark on a bold experiment. With billions of dollars and the drinking water of nearly ten million people at stake, planners weighed the costs and benefits of two alternative solutions to their water problem—constructing a filtration plant or repairing the largely natural filtration system that had been purifying the city's water all along. Nature won. And in a turn of events that would have global implications, it won on economic grounds.

The battlefield on which this victory was achieved is the Catskill/Delaware Watershed, the heart of New York's purification and delivery system, named after the two major rivers flowing from it. This rural landscape is famed as a scene of great beauty, but it's also a highly efficient and valuable machine—its cogs two thousand square miles of crop-filled valleys and mountains blanketed in forest, all connected by meandering streams feeding into an extensive system of reservoirs. For nearly a century, the complex natural system had been delivering water of exceptional purity to the people of New York City and several upstate counties. In recent years, it produced as much as 1.8 billion gallons per day, serving New Yorkers with a healthy drink whose taste and clarity were the envy of mayors throughout the United States. And unlike most other large U.S. cities, New York's tap water has never passed through a filtration plant.

Instead, the water, born as rain and melted snow on mountaintops as far as 125 miles away from those who will ultimately drink it, is naturally cleansed as it makes its way downhill toward the reservoirs. Beneath the forest floor, soil and fine roots filter the water and hidden microorganisms break down contaminants. In the streams, plants absorb as much as half of the surplus nutrients running into the waterway, such as nitrogen from automobile emissions and fertilizer and manure used on nearby farms. In open stretches, wetlands continue the filtering as cattails and other plants voraciously take up nutrients while trapping sediment and heavy metals. After reaching the reservoirs, the water is further cleansed as it sits and waits. Dead algae, floating branches and leaves, and remaining particles of grit slowly sink to the bottom.

This natural process, supplemented by small doses of chlorine and fluoride at the end of the water's journey, worked beautifully for most of the

twentieth century. But then signs appeared of some mechanical failures. The trouble was relentless new development: roads, subdivisions, and second homes were popping up all over the watershed, most of which is privately owned. Failing septic systems were leaking raw sewage into streams. Farming and forestry were also taking a toll, with lawn chemicals, fertilizers, pesticides, and manure all being washed into the reservoirs at an unprecedented rate.

By 1989, these problems could no longer be ignored. Congress that year amended the Safe Drinking Water Act, putting into motion a major review of the country's drinking water systems. New York City was faced with the potentially enormous cost of an artificial water filtration plant, estimated at as much as $6-$8 billion, plus yearly maintenance expenses amounting to $300-$500 million. That price tag meant potential catastrophe for New York's budget, and city officials were determined to avoid it. With vigorous lobbying, they won agreement from federal regulators to try an alternative: rather than pay for the costly new filtration plant, the city would spend the much smaller amount of about $1.5 billion to protect the upstate watershed, by buying land as buffers and upgrading polluting sewage treatment plants, among other tactics. The EPA, in turn, would grant a five-year reprieve of its order.

The scheme was seriously challenged from the start. Powerful developers filed suit, claiming that property values would plummet as the city imposed restrictions on new construction. Environmentalists criticized the city's efforts as too weak. Nonetheless, the unprecedented agreement was a milestone in a world in which nature's labor has too long been taken for granted. A major government body had acted as if an ecosystem—the watershed—were worth protecting in its natural state for the economic benefits it gives society. It had invested in its restoration as if it were in fact a precious piece of infrastructure.

Around the world, in city offices and university conference halls, among small groups of community activists and at the World Bank, scientists, legal scholars, bureaucrats, and professional environmentalists debated the implications of New York's experiment. Could it possibly work? Did scientists know enough about the mechanics of watersheds to give reliable advice on their management? And, assuming the approach turned out to be justified, how widely could it be replicated?

In fact, without clear answers to these questions, and in many cases without knowing much about New York, governments around the world—in Curitiba, Brazil; in Quito, Ecuador; and in more than 140 U.S. municipalities, from Seattle, Washington, to Dade County, Florida—were starting to calculate the costs of conserving watersheds and compare them with the costs of building mechanical plants. In a bold departure from business as usual, they were taking stock of their natural capital. In the process, they were learning how ecosystems—environments of interacting plants, animals, and microbes, from coastal tide pools to Loire Valley vineyards to expanses of Amazonian rainforest—can be seen as capital assets, supplying human beings with services that sustain and enhance our lives. These "ecosystem services" provide not only food and wine but also cleansing of the Earth's air and water, protection from the elements, and refreshment and serenity for human spirits.

Historically, the labor of nature has been thought of mostly as free. And with the exception of a few specific goods, such as farm crops and timber, the use of nature's services is startlingly unregulated. Despite our assiduous watch over other forms of capital—physical (homes, cars, factories), financial (cash, savings accounts, corporate stocks), and human (skills and knowledge)—we haven't even taken measure of the ecosystem capital stocks that produce these most vital of labors. We lack a formal system of appraising or monitoring the value of natural assets, and we have few means of insuring them against damage or loss.

Although governments have negotiated a wide array of global and regional agreements to protect certain ecosystems from degradation and extinction—such as the Ramsar Convention on Wetlands, the Convention on Biological Diversity, and the Convention on the Law of the Sea—these agreements are mostly weak, lacking the participation, resources, and systems of incentives and enforcement they need to be effective.

Even more striking is how rarely investments in ecosystem capital are rewarded economically. Typically, the property owners—whether individuals, corporations, governments, or other institutions—are not compensated for the services the natural assets on their land provide to society. With rare exception, owners of coastal wetlands are not paid for the abundance of seafood the wetlands nurture, nor are owners of tropical forests compensated for that

ecosystem's contribution to the pharmaceutical industry and climate stability. As a result, many crucial types of ecosystem capital are undergoing rapid degradation and depletion. Compounding the problem is that the importance of ecosystem services is often widely appreciated only upon their loss.

The source of this predicament is easy to comprehend. For most of humankind's experience on Earth, ecosystem capital was available in sufficient abundance, and human activities were sufficiently limited, so that it was reasonable to think of ecosystem services as free. Yet today, nature everywhere is under siege. Each year the world loses some thirty million acres of tropical forest, an area slightly larger than Pennsylvania. At this rate, the last rainforest tree will bow out—dead on arrival at a sawmill or in a puff of smoke—around the middle of the twenty-first century. Biodiversity is being reduced to the lowest levels in human history. Homo sapiens has already wiped out one-quarter of all bird species, and an estimated eleven percent more are on the path to extinction, along with twenty-four percent of mammal and eleven percent of plant species. One-quarter of the world's coral reefs have been destroyed, with many others undergoing serious decline. To top it off, we're taking fish out of the sea for consumption faster than they can reproduce.

The twenty-first century began with a growing sense among scientists that crucial thresholds had been reached and time to fix things was running out. This increasingly apparent deadline has begun to inspire a shift in thinking for many scholars, most notably economists. To be sure, economists have long been concerned with issues of resource scarcity and limits to human activities. That's why their field was dubbed "the dismal science." Yet throughout the 1960s, '70s, and '80s, most economists clashed with ecologists. Economists accused ecologists of being alarmist about adverse human effects on Earth and of proposing costly and unnecessary measures of protection. Meanwhile, ecologists charged economists with promoting "growth" at any price and misusing partial indicators of well-being, such as the gross national product, that are blind to wear and tear on the planet.

This conflict began to ease in the late 1980s, however, with efforts to forge a new discipline integrating ecology and economics. An early participant in this movement was Stanford professor and Nobel laureate Kenneth Arrow, who for decades has been disturbed by the way economics dismisses

"externalities," activities of which there are two types. Positive externalities are activities that benefit people who don't pay for them; negative externalities harm people who don't receive compensation.

An example of a positive externality is modern Costa Rica's careful stewardship of its forests—a striking turnabout from the rampant deforestation that lasted into the 1980s. The new conservation policies contribute to sustainable development in the region while also helping to stabilize the global climate and maintain biodiversity. Yet for the most part, only Costa Ricans pay for these widely enjoyed benefits. In contrast, a negative externality occurs when Americans drive gas-guzzlers. This activity contributes to air pollution, potential climate change, and the risk of the U.S. being drawn into foreign conflicts over oil. Yet even though these negative consequences affect large numbers of people, the drivers—since U.S. gas is cheap and relatively untaxed—don't pay the costs.

"Internalization" of such externalities—enactment of a system of fair pricing and fair payment—is badly needed, but it will not be simple. Arrow has tried to meet the challenge in part by joining other economists and ecologists in a growing effort to "rethink economics," a process fortified by their yearly meetings in Sweden.

Another major player in these meetings has been Cambridge University professor Partha Dasgupta. Born in India, Dasgupta has devoted much of his career to studying the interplay of overpopulation, poverty, and environmental degradation. He remembers being stunned, at a United Nations meeting in 1981, when economists from developing countries stood up one by one and told him they couldn't afford to protect their environments. The encounter, he later said, showed him "how far we had yet to go. We must stop viewing the environment as an amenity, a luxury the poor can't afford." Quite the contrary, Dasgupta is convinced that the local environment is often the greatest asset for poor families because they have few alternatives for income if it fails. The rich, by contrast, have a global reach for all sorts of ecosystem goods and services, as revealed by their dinner tables laden with fresh fruit, fish, spring water, and flowers from all over the planet. Ultimately, though, the rich are also vulnerable to faltering ecosystem services and the social instability that can arise as a result.

Important as they clearly are to rich and poor alike, ecosystem services typically carry little or no formally recognized economic value. As Columbia University economist Geoffrey Heal points out, economics is concerned more with prices than with values or importance. "The price of a good"—say, a loaf of bread or a car or a piece of jewelry—"does not reflect its importance in any overall social or philosophical sense," says Heal. "Very unimportant goods can be valued more highly by the market—have higher prices—than very important goods."

This contradiction isn't new. Economists throughout the eighteenth and nineteenth centuries were perplexed by the paradox of diamonds and water. Why do diamonds command a much higher price than water, when water is obviously so much more key to human survival? The answer, proposed by Englishman Alfred Marshall, is now common knowledge: price is set by supply and demand. In the case of water, Heal explains, the supply (at least in Marshall's England) "was so large as to exceed the amount that could possibly be demanded at any price. Consequently the price was zero; water was free. Now, of course, the demand for water has increased greatly as a result of population growth and rising prosperity, while the supply has remained roughly constant, so that water is no longer free." Diamonds, by contrast, started out scarce: the desire for ownership always exceeded their supply. Their market price was thus high—set by rich people competing for the few diamonds available.

Ecosystem assets are gradually acquiring the scarcity of diamonds as the human population and its aspirations grow. As they become more like diamonds, they take on increasing potential value in economic terms. But major innovations to our economic and social institutions are needed to capture this value and incorporate it into day-to-day decision-making.

The main challenge in the pursuit of this goal is that most ecosystem services are currently treated as "public goods," which if provided for one are provided for all, no matter who pays. An example is air quality: if a government spends on reducing pollution, it helps taxpayers and non-taxpayers alike. That leads to a problem of "free riders," in which some people benefit without charge from services paid for by others. And this is particularly true with the services provided by nature. Although we've engineered a financial system so

sophisticated as to include market values for feng shui masters and interest-rate derivatives, we've not yet managed to establish them for such vital and everyday services as water purification and flood protection.

The big challenge now is how to measure, capture, and protect these newly discovered values before they are lost. Since the late 1990s, there's been an urgent flurry of calls to do just that, yet not until New York made its historic decision to invest in its watershed did it seem possible that big governments would catch on, supporting the concrete results of nature's work with cash on the table. Replicating that endeavor to any great extent, by conserving not only watersheds for water purity but also wetlands for flood control and forests for climate stabilization and biodiversity conservation, would require a tremendous amount of new scientific understanding of ecosystems—of their functioning, of their susceptibility to adverse human effects and their amenability to repair, and of the pros and cons of replacing them with technological substitutes. More important, it would require a willingness to look at the world's economy in an entirely different way, starting with the assumption that ecosystems are assets whose output has concrete financial worth.

Next, we need to change the rules of the game so as to produce new incentives for environmental protection, geared to both society's long-term well-being and individuals' self-interest. One way to do this is with taxes and subsidies targeting major environmental externalities, a strategy widely employed in Europe. A tax on consumption of fossil fuels, for instance, makes users of a shared resource—in this case, the sky, being used as a dumping ground—reduce their consumption and the damage it causes. It also makes higher-priced alternative energy sources (with lower environmental costs) more financially attractive. Consumption taxes such as this can be offset by reductions in income tax rates. In the U.S., however, such taxes have been virtually impossible to pass through Congress.

Another tactic, sometimes more politically feasible, is to establish ownership of ecosystem assets and services. This can avert the famous "tragedy of the commons" that often occurs when there is open access to a natural resource. It happens because each individual has more to gain by, say, launching another fishing boat than to lose by depleting the fishery. But when

ownership rights to nature's goods and services are assigned, the new owners —be they private citizens, communities, corporations, interest groups, or governments—face unshared risk of those rights diminishing in value. Thus, as explained by economist and Nobel laureate Ronald Coase, they are motivated to fight for the asset's protection.

Establishing ownership of natural capital and services enables the process of bargaining between those affected by an externality and those causing it. Creating a place where people can get together to bargain—a market, whether in the town square or on the internet—is an old approach being newly applied to capture the value of ecosystem assets. A premier example is the evolving legal concept of "carbon rights"—ownership of the capacity of forests to stabilize climate by absorbing carbon dioxide. Efforts are underway to establish such rights and develop international markets for the purchase and sale of this forest ecosystem service, which in turn would establish a "market value," or price.

"Without prices being set, nature becomes like an all-you-can-eat buffet —and I don't know anyone who doesn't overeat at a buffet," says Richard Sandor, an environmentally minded financial innovator based in Chicago. Sandor has been a leading pioneer in looking at the problem of our dwindling resources in a striking new way. He and others have begun to act, launching bold initiatives to find financial incentives for environmental conservation.

One thing is clear: private enterprise cannot substitute for governments, particularly in view of the increasing risk of climate change, a global problem requiring global cooperation if it's not to override all other environmental and economic worries in a matter of decades. Government regulation may be called for to kick-start and supervise the profound economic transformation needed to ward off this and other environmental threats. Yet this transformation can be speeded with the use of market mechanisms and other financial incentives, tactics that have been glaringly underemployed.

Whether they appeal to us or not, experiments in finding market values for such essential gifts of nature as clean water and fresh air are well underway. The great unanswered question in all of this is whether the drive for profits, which has done so much harm to the planet, can finally be harnessed to save it.