

Science

FINDINGS

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“Science affects the way we think together.”

Lewis Thomas

Ecosystem Service Markets 101: Supply and Demand for Nature



Tom Iraci

The term “ecosystem services” is one way to describe the ways in which people benefit from nature. Clean water and air, wildlife habitat, and scenic beauty are examples of services provided by a healthy ecosystem.

*“When the well is dry, we
know the worth of water.”*

—Benjamin Franklin

The world’s growing population and higher standards of living are placing increasing pressure on the natural resources that are essential to life. As clean water, open space, and the ability of oceans and forests to regulate climate decline, society looks for ways to ensure that adequate supplies of natural resources will be available in the future.

Concepts such as environmental stewardship and a land ethic acknowledging that the health of the environment is integral to human health are not new. The term “ecosystem services,” which entered the lexicon in the 1990s to describe all the attributes of an ecosystem

that benefit humans, is a variation on that theme. The new twist is widespread interest in using markets to promote stewardship. In some circles, ecosystem service markets have become buzzwords, exciting proponents with their potential to finance the conservation of threatened ecosystems.

Carbon markets, in particular, have been the source of much discussion and may be of particular interest to forest owners. Carbon dioxide is a key greenhouse gas contributing to global climate change. Human sources of carbon dioxide include coal-fired power plants and vehicle emissions. Trees naturally absorb carbon dioxide during photosynthesis, removing it from the atmosphere. That carbon dioxide remains sequestered in wood, either as part of the living tree or as a wood product.

IN SUMMARY

Establishing markets for ecosystem services—the benefits that nature provides, such as clean air, water, and wildlife habitat—has gained traction in some circles as a way to finance the conservation of these public goods. Market influences on supply and demand work in tandem to encourage ecosystem protection.

Jeff Kline and Trista Patterson, scientists with the Pacific Northwest (PNW) Research Station, have identified several criteria needed for ecosystem service markets to achieve their potential. These include regulatory limits on environmental damage, ecosystem services that are amenable to trading, and manageable transaction costs related to administering market programs and the necessary measuring and monitoring of marketed resources. If these criteria are not met, other conservation methods such as conservation easements, landowner incentive programs for environmental enhancement or protection, or taxes on environmental damage may be more effective.

Discussions about ecosystem services often focus on increasing supply—storing more carbon or delivering more water, for example. However, net pressures on ecosystems can also be reduced by addressing consumption. Many energy efficiencies can be achieved by promoting awareness, informed choices, and behavior change. The PNW Research Station is examining both supply and demand approaches to ecosystem protection by encouraging the development of ecosystem services markets and identifying ways to reduce its own environmental footprint.

In a carbon market, carbon credits—the right to emit carbon—are bought and sold. A business unable to further reduce its own carbon emissions could instead buy credits from a seller who in return acts to sequester carbon equivalent to the buyer's emissions. Forest land owners, for example, could participate in a carbon market and sell carbon credits by increasing the amount of carbon stored on their land via longer rotation lengths or by planting more trees. Similarly, marginal cropland might be planted with trees, if the value of carbon credits made carbon sequestration more profitable than farming.

Development is one of the biggest threats to private forests. Once forests are converted to more developed uses, the ecosystem services they provided, such as carbon sequestration, water filtration and storage, wildlife habitat, and recreational opportunities, are reduced or lost. Proponents argue that markets for ecosystem services are an economically efficient way to encourage private land owners to continue managing their land in ways that produce public benefits for society.

LAYING THE GROUNDWORK

Jeff Kline and Trista Patterson, research economists with the Pacific Northwest Research Station, have studied market-based approaches to providing ecosystem services and have concluded that certain criteria need to be met for ecosystem service markets to achieve their potential. A key criterion is adequate regulation—a cap—that limits the

amount of environmental damage and creates incentives for changing both supply and demand behavior.

The “invisible hand” has long been a metaphor for explaining the self-regulating nature of markets. The price of a good or service generally increases as a good or service becomes scarce, prompting existing producers to

increase the quantity they supply to meet demand. Rising prices may also entice new producers to enter the market. Markets for ecosystem services work the same way but require a regulatory framework to establish the legal parameters for trading to be functional, effective, and enduring. “Without that regulatory framework, you can’t have an ecosystem services market,” says Kline.

KEY FINDINGS	
•	In the Forest Service, the general approach to addressing ecosystem services has been to manage the national forests to maintain or enhance ecosystem services, while providing incentives to private landowners to maintain or improve the supply of ecosystem services on private lands. Another consideration is to change consumption habits that ultimately put pressure on ecosystems.
•	Markets for ecosystem services potentially can encourage ecosystem protection and change peoples’ consumption behavior simultaneously by addressing both supply and demand. However, markets can be more complex to implement than traditional incentive programs.
•	Some ecosystem services are more amenable to trading in markets than others. The ability to cost effectively measure and monitor a given service is a critical indicator of market suitability. Suitability is enhanced when the connection between a threat to a given service and a consumptive behavior is readily apparent to consumers.
•	Other approaches focus on reducing demand. For example, estimating a replacement cost of the services produced from a healthy ecosystem raises awareness among consumers about the value and vulnerability of the ecosystems before those services are lost, and may create incentives to reduce consumption.

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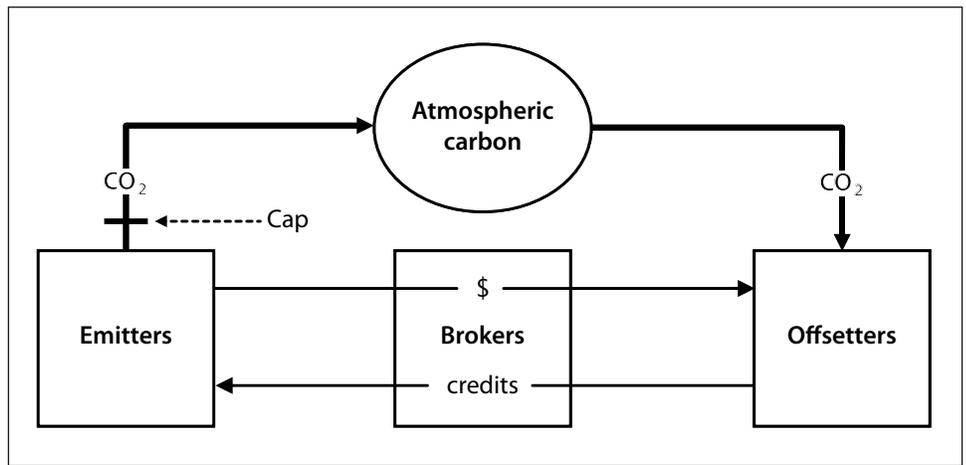
Tom Iraci

Ecosystem service markets, cost-share incentive programs, regulation, and pollution taxes are various approaches to ecosystem protection. Different approaches can be effective in different situations.

The now defunct Chicago Climate Exchange (CCX) is a case in point. The CCX was an experimental, voluntary carbon market that opened in 2003. At the time, many people thought the federal government would soon initiate a regulatory cap on carbon emissions. About 450 companies participated in the program, which facilitated buying, trading, and selling of carbon offsets to meet carbon reduction commitments. In 2010, however, Congress declined to establish a cap on carbon and at the end of that year, the CCX closed. The closing exchange trading price was 5 cents per metric ton of carbon-dioxide-equivalent emissions, down from a high of \$7.50 per metric ton of carbon-dioxide-equivalent.

For a market to work to its full capacity, Kline explains, socially acceptable limits to environmental damage need to be established. “It’s not the market that limits the environmental damage; it’s the environmental regulation that is established when the market is created that limits the damage,” Kline points out. “The market just determines who gets to do the damage.”

The sulfur dioxide market regulated by the Environmental Protection Agency, for example, has effectively addressed the acid rain



In a carbon cap-and-trade program with offsets, an emitter can buy credits to offset carbon emissions above their cap. The offsetter who sells those credits then acts to offset the emissions by sequestering an equivalent amount of carbon.

damage that afflicted the northeastern portion of the United States in the 1970s and 1980s. A federal cap on permissible levels of sulfur dioxide emissions was established, primarily affecting coal-burning power plants. The combination of relatively few emitters and a clearly defined point source made the program relatively easy to regulate and monitor. A cap-and-trade mechanism was implement-

ed, and the regulatory cap effectively moved the industry toward cleaner technology.

In the absence of a federal program, regional carbon markets in the United States are emerging. In the northeast, the Regional Greenhouse Gas Initiative, which took shape in 2005, has 10 participating states. In California, a voter-approved carbon market opened for business in January 2012.

CONSIDERING A RANGE OF OPTIONS

“If you’re going to consider markets, you need to compare their effectiveness against regulation, taxes, and education, because different policies can work in different situations,” Kline says. “Carbon is an area where a market could work, as long as there is well-designed regulation to back it up. It’s relatively easy to regulate and monitor, because you know how much carbon is emitted when you burn a barrel of oil or a ton of coal.” He continues, “Of course you could just establish a tax on fossil fuels and avoid the complexity in establishing a carbon market.”

Some ecosystem services are more amenable to trading than others, Kline explains. “Some kinds of environmental damage don’t lend themselves well to environmental markets because they are more difficult to measure and monitor, or because the relationship between production and damage is not well established.”

The transaction costs associated with trading are another factor to consider. “It might cost too much to participate in an ecosystem services market because you’d need to negotiate credit trading and then measure and monitor to verify that participants are complying with the rights they’ve acquired in the market to commit environmental damage,” Kline says.

“If it costs potential participants too much to participate, they won’t.”

Other methods for reducing environmental damage, such as regulation, taxes, or subsi-

dies, can experience some of the same challenges faced by ecosystem service markets. Any of these methods, for example, could inadvertently move the environmental damage down the road. Delaying timber harvests



Jeff Kline

Forest land owners might participate in carbon markets by selling carbon credits in return for increasing the amount of carbon stored on their land by delaying timber harvests or by planting more trees.

in one place, for example, could result in more harvests elsewhere, perhaps in a country with less environmental regulation. Kline points out, however, that these other methods may make up for those shortcomings if they can be more easily modified in response to new information.

“With regulation, taxes, or subsidies, if a regulatory agency sees a need to increase the level of ecosystem protection, the agency can tighten the regulation, increase the tax level, or increase the subsidy,” he explains. “With markets, regulatory agencies would need to reduce the supply of damage allowances in the market, which could be more difficult.”

Regardless of the mechanism used, it’s important to keep in mind that the goal is to sustain the flow of benefits to people, in perpetuity. When using markets to achieve this goal, success cannot be measured by the number of market exchanges or the dollar value of transactions if it is not quantifiably tied to a resulting level of protection.



Tom Iraci

In the American West, about 50 percent of the water supply originates on national forests and grasslands.

ESTABLISHING THE FEEDBACK LOOP

“If everyone on Earth consumed resources like an American, we would need multiple planets worth of ecosystems producing those services,” says Patterson. “Worldwide, we are consuming resources faster than the planet can replenish them.”

Discussions in forestry about how to maintain ecosystem services generally focus on supply: finding ways to maintain or increase supplies of ecosystem services to meet growing demands. The role that other types of strategies can play in reducing demand has gotten far less attention. “Even the healthiest ecosystems have an upper limit to what they can supply in perpetuity. It is often far less costly to prevent these losses than to pay for replacement at a later date,” Patterson explains.

“Ecosystems are naturally resilient,” Patterson continues, “but compounded pressures lead to vulnerabilities and volatilities that affect businesses, households, and communities. If we’re using financial incentives to replant trees in some areas, for example, we can’t replant fast enough to make up for all the ecosystem services we are currently using. This is why we’re concerned about the impact to community sustainability and resilience over time—we’re not creating the true feedback loops needed to correct the situation.”

“Technology can substitute for some of nature’s services in the future, but because many of them are invisible to us, we rarely pay for them directly,” she says. When producers have to buy the right to commit environmental

damage, ecosystem services markets provide a price signal to consumers who demand the products or services. Patterson believes creating public awareness is another critical key to establishing a feedback loop.

She points out that because national forests produce so many critical ecosystem services, there is significant opportunity for the Forest Service to play a role in the education process. For example, national forests provide about 18 percent of the nation’s water. In the West, the contribution is even greater, with about 50 percent of the water supply originating from national forests and grasslands. “But how many people know which national forest their drinking water comes from?” Patterson asks. “Or, how many acres of forest land are needed

to yield the amount of water you use in a year? How many people know how many trees it takes to sequester the carbon emitted by their lifestyle?”

One solution is to find effective ways to communicate the benefits of becoming a more informed decisionmaker or consumer. As research lead for the Forest Service Sustainable Operations Western Collective, Patterson illustrates her point with examples of where innovation, collaboration, and an aggressive stance against waste has reduced energy consumption costs, greenhouse gas emissions, and trash production. These efforts reduce pressures on ecosystems and taxpayers alike. The collective is using various mechanisms to reduce the agency’s ecological



Rhonda Mazza

Once forests and grasslands are developed, their ability to provide ecosystem services is diminished.

footprint, including energy consumption and carbon dioxide emissions. One weekend in August 2010, for example, federal employees in the Yates Building in Washington, D.C., unplugged everything from computers and printers to coffeemakers and electric pencil sharpeners. The result: 70 percent less electricity was used compared to the previous weekend. In that one weekend, 10.9 tons of carbon dioxide emissions were avoided, equal to saving 1,220 gallons of gas, and the agency saved \$2,100 in utility costs. This exercise is now being replicated across the nation. The raised awareness often appears to lead to permanent energy saving strategies.

In another pilot project, fuel gauges that provide real time feedback on fuel consumption were installed on six Forest Service vehicles on the Colville National Forest. In one month, as drivers became better at “eco-driving” techniques, those six vehicles were able to save 123 gallons of gas, prevent 1.2 tons of carbon dioxide from entering the atmosphere, and save more than \$400.

“We often rely on the technical ‘fix,’ but behavioral change yields the highest returns



Bruce Kelpas

Existing methods for protecting open space include conservation easements, zoning, and incentive programs for land owners, including reduced property taxes for forest and agricultural land.

on investment,” says Patterson. “This is an area that has been largely unexplored because we have relied too much on price. Price often doesn’t provide an adequate signal. Reducing our ecological footprint doesn’t have to be

about sacrifice,” Patterson contends. “It can be as simple as turning off your computer when you leave the office on Friday, or spending time with family or friends on a walk outdoors.”

LEAVING SPACE FOR NATURE

Nature needs room to operate. Keeping forests as forests and protecting grasslands and other open space is ultimately what is needed to maintain ecosystem services. For some ecosystem services, a market may be a viable mechanism to encourage landowners to turn down tempting financial opportunities offered by development. Given the complexity of establishing an effective market, however, other proven land conservation methods should not be overlooked.

Kline and Patterson point out that federal, state, county, and municipal governments and nongovernmental organizations have long provided funding to purchase development rights, conservation easements, and land. Private forest land and other open space also receive preferential tax assessment for property tax purposes.

Public support is critical, regardless of the mechanism used. The ecosystem service framework is a “convenient way to foster

intervention on behalf of ecosystems by cleanly defining what is at stake with ecosystem decline and corresponding protection efforts,” the scientists explain. Its greatest utility may be in helping more people understand the connections between conservation and quality of life and that addressing and preventing ecosystem service declines is necessary, beneficial, and cost-effective for present and future generations alike.

“The real voyage of discovery consists not in seeking new landscapes but in having new eyes.”

—Marcel Proust

FOR FURTHER READING

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 LAND MANAGEMENT IMPLICATIONS 
<ul style="list-style-type: none"> Ensuring sustained flows of benefits to present and future generations is a fundamental rationale for government involvement in protecting ecosystem services and managing the public lands that provide them.
<ul style="list-style-type: none"> Creating ecosystem services markets is one of many approaches that could encourage the conservation of ecosystems that provide them. Other approaches include regulation, cost-share incentive programs, and taxing the behavior that damages ecosystems. Different policy approaches can be effective in different situations.
<ul style="list-style-type: none"> Policies that address demands for ecosystem-damaging products and activities can complement supply-side policies and promote greater protection. Educating consumers about how their decisionmaking and consumption choices affect ecosystems can help to conserve productive capacity and sustain ecological function.

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