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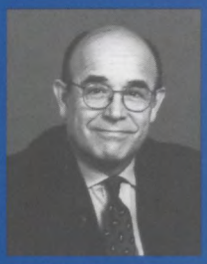
RESOURCES

RESOURCES FOR THE FUTURE RESEARCH THAT MAKES A DIFFERENCE



Paul R. Portney

Follow the Dollar: Over Time, Over Land

This latest issue of *Resources* illustrates the temporal sweep of RFF's work. On page 8, readers will find a story about the new RFF book *Discounting and Intergenerational Equity*. Though my name appears as the byline on the story and as co-editor of the book, it's the contributions of others that make the book exciting.

What you'll find are the musings of some of the world's foremost economists—including two former Nobel prize winners and several good bets for future awards—on a decisionmaking technique called discounting. This technique makes it possible to compare costs and benefits that won't be realized for hundreds of years with those we will experience tomorrow.

Urban sprawl and habitat disruption are making headlines and animating campaign speeches today. Underlying the rhetoric are important questions about land use. One of the most important of these is: How can we protect key parcels of land as inexpensively as possible? Of course, the answer depends on getting down to specifics, such as those set out in the two features in this issue.

Jim Boyd, Kathryn Caballero, and David Simpson give us a guide to the legal instruments still evolving for land preservation. Balance is the challenge that these researchers see, while the cardinal rule is first to recognize that foregone development always costs somebody something. The key to conservation, then, is to make conservation worth somebody's while by using market-based incentives, such as the easements the authors zero in on here.

Meanwhile on another continent, the struggle is starker and the strategies simpler. For all the differences between the Brazilian Amazon and the American suburbs, however, the recommendation remains the same: to conserve habitat, offer economic incentives.

Having conducted hundreds of personal interviews along the Transamazon Highway, Charles Wood and Robert Walker report that subsistence farmers are less likely to cut down trees if they own the land on which they stand. Their survey, the researchers say, provides empirical support for the contention that property rights are indeed a powerful conservation tool whose scope and definition should be expanded.

As the lead story in "Goings On" indicates, we continue to host thinkers across disciplines and around the world who are exploring the potential problem of climate change. As a matter of fact, *Resources* doesn't have enough pages to cover all of the new ideas and activities at RFF on this and other topics. As always, we are grateful to our readers whose support makes this delightful predicament possible. Readers who can should visit our Web site for more (*http://www.rff.org*) or call or write. One way or the other, we hope you'll stay tuned and in touch.

Paul Portney

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GOINGS ON

Are we getting warm yet?

Since designing climate policy requires an understanding of the underlying science, RFF recently convened three eminent climate scientists—and two science journalists—for a debriefing on the latest known information.

The scientists who sat on the **RFF Climate Science Forum** panel in June described the uncertainties that hamper climate forecasting and noted the progress made to overcome them. With varying degrees of optimism, they estimated when we can expect computer models to predict climate change with any real accuracy.

Tom M. L. Wigley of the National Center for Atmospheric Research observed how far we have come in enhancing the precision of models to reflect the past climate record, which bodes well for their power to predict the future. Meanwhile, the evidence is growing, he said, that human beings have had a hand in causing a global temperature rise in the past century. Even some leading skeptics, he claimed, now say the evidence is enough to discern our influence.

While also citing modeling advances, **Ronald Prinn** of the Massachusetts Institute of Technology noted the need to better understand the phenomena—the oceans, clouds, glaciers, and aerosols in the atmosphere—whose mysterious workings cast doubt on climate models and forecasts, however much improved.

Despite progress, **Michael Schlesinger** of the University of Illinois at Urbana-Champaign said he thought climate change forecasts would not be "unequivocal" until the latter half of the 21st century. But imperfect models are not to be dismissed, he strongly implied, considering the latency of climate effects. Carbon emissions dwell in the atmosphere long after they're emitted, Schlesinger explained. Thus, if we waited until we could actually see their effect on temperature, we would have little time to respond. It's not a good idea, he added, to require the "equivalent of the ozone hole" before we take action.

Like many a policy analyst, Schlesinger the scientist argued for an adaptive approach: take some mitigative action now and then modify it up or down as the scientific indicators become more precise.

RFF convened the forum to air the latest scientific findings since the United Nations Intergovernmental Panel on Climate Change issued its 1995 report.

SYLVIA JOHNSON

Richard Kerr of Science magazine and Curt Suplee of the Washington Post put questions to the panel scientists at RFF's Climate Science Forum.

For more information, visit *http://www.weathervane.rff.org*, RFF's digital forum on global climate policy.

SYLVIA JOHNSON

Panel moderator J.W. Anderson and climate scientist Michael Schlesinger field questions from the forum audience.

SYLVIA JOHNSON

Climate scientists Tom M. L. Wigley and Ronald Prinn share their thoughts.

GOINGS ON

Expanded trading

Incentive-based approaches to controlling air pollution sound great on paper: Give the nation's coal-fired electric power plants permits to emit a certain amount of acid-rain-producing sulfur dioxide annually. Let each plant use the permits itself, save them for later, or—if clean enough to afford to—sell some to another utility, hungry for extra allowances. That's the gist of the program that EPA developed under Title IV of the 1990 amendments to the Clean Air Act.

Considering how much sense it makes compared with "command and control" regulations, why hasn't such an approach caught fire and spread outside the SO_2 program?

RFF Senior Fellow **Dallas Burtraw**, who has analyzed emissions trading since its inception, hears that question a lot. The main reason, he answers, is that efficiency, equity, and administrative issues make the permit process more complex than imagined and often not well understood.

Still, tradable pollution permits are hardly languishing in some dark corner of the ivory tower. Far from it, says Burtraw, who hosted RFF's small conference on the subject in April, which brought together U.S. and European representatives of regulatory agencies, electric utilities, environmental advocacy groups, academics, and policy analysts.

As the meeting made clear, interest is growing in how to use emissions permit trading in a variety of regulatory settings.

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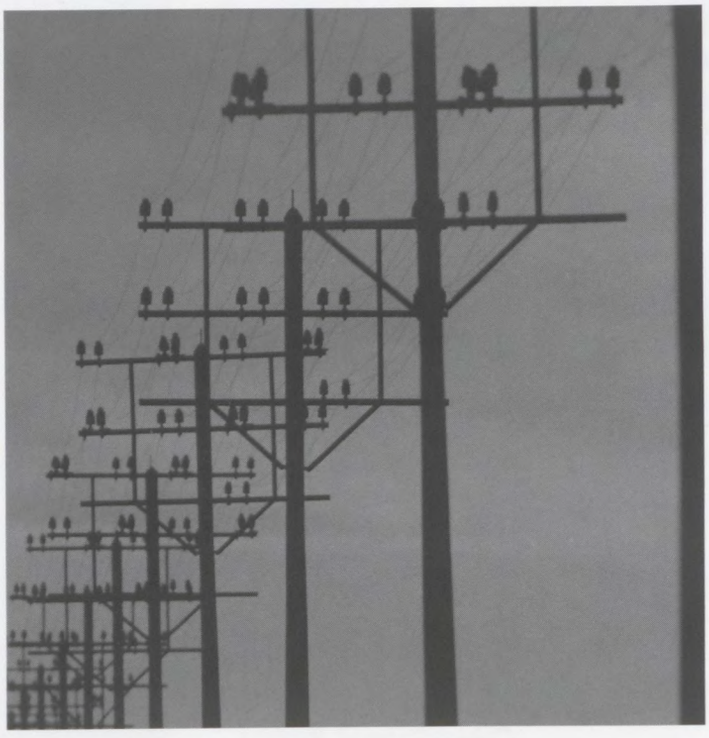


What's more, interest is growing in new ways to allocate permits.

For now, the method most commonly used is that created under EPA's acid rain program in which allowances are allotted to existing emitters based on their historic electricity generation.

Though not controversial when the innovative program started in 1990, this allocation scheme is now recognized as having effected large transfers of wealth. After all, these emissions allowances are worth money. When allocated for free to existing emitters, they constitute a marketable asset that can be sold or—if an emitter needs to use them—recouped by charging electricity customers their value.

The facilities that benefit may consider such transfers appropriate compensation for their investments in pollution reduction. Economists, meanwhile, have focused on the efficiency implications of this approach, compared with other allocation schemes such as government-sponsored auctions of allowances that raise revenue. These economists include Burtraw, RFF Fellow **Ian Parry**, and **Lawrence Goulder**, who is an RFF university fellow and professor at Stanford University.

At the RFF conference, the focus fell on allocating permits based on future projections of energy production rather than past performance. **Thomas Sterner**, an RFF Gilbert F. White fellow and professor at Sweden's Goteborg University, described how this forward-looking method is used to regulate nitrogen-oxide emissions in that country. Conference participants also heard from RFF Fellow **Carolyn Fischer**, who has laid the theoretical groundwork for understanding the merits of such an approach.

"Rarely does the timing of new thinking in economic theory coincide so closely with current public policy as it does in this case," Burtraw noted.

Burtraw was referring to EPA's proposed new trading program for nitrogen-oxide emissions in the eastern United States and the possibility that EPA may decide to opt for a future-production-oriented allocation scheme along the lines discussed at the conference. Burtraw and RFF Senior Fellow **Karen Palmer** presented results from a simulation model that addressed just how such an approach would affect investment and operation of existing plants in the electricity industry. A final decision about the new program is pending.

In the long run, Burtraw thinks, EPA's consideration of such a scheme may signal an important transition. Eventually, permit trading systems may combine the "compensation benefits" of allocating permits at zero cost with the "efficiency benefits" of charging emitters for permits, perhaps through a revenue-raising auction.

Seeking a vision for the trees

The U.S. Forest Service needs vision. On that point everyone gathered at the RFF conference to honor the late **Marion Clawson** agreed. The lack of a clear mission stood in stark contrast to the sweep and clarity of the man they came to remember. Clawson, who literally wrote the book on assessing the value of outdoor recreation had an eagle eye that gazed out over the land for more than seventy years, those present recalled.

When he died in April 1998 at the age of ninety-two, the senior fellow emeritus had set a standard for the study of agriculture, park and forest use, outdoor recreation, and land development. His influence on policy analysis in these areas is likely to continue through the forty books he authored, such as the widely read *Economics of Outdoor Recreation* and *Forests for Whom and for What?*

Yet as Clawson himself noted near the end of his long life, huge shifts have taken place in American attitudes toward public forests, heightening tensions among the competing ways in which they can be treated and used. He noted the surge in the number of people concerned about environmental problems associated with forest harvesting. He noted, too, a rise in widespread technical knowledge and with it a new aggressiveness in advocacy.

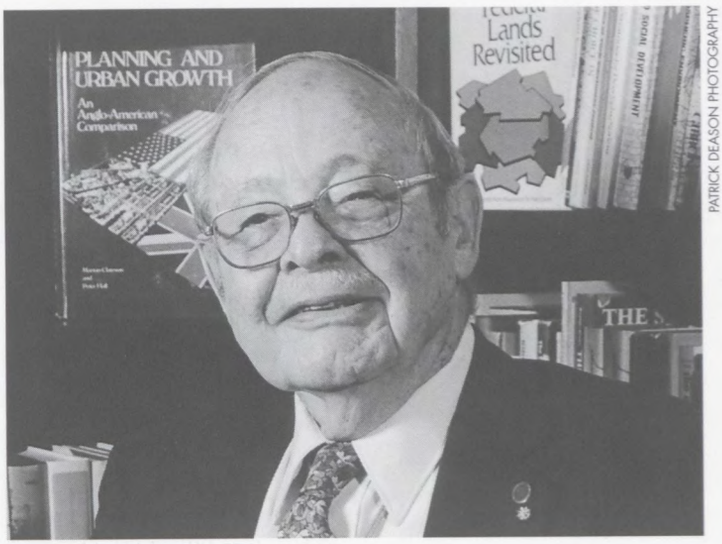
As former U.S. Forest Service Chiefs **Max Peterson** and **Jack Ward Thomas** remarked at the conference, preferences for biodiversity and recreation now overshadow the more traditional role of U.S. forests as a source of timber. The upshot is that the agency that manages American federal forest lands is in a state of transition as it enters the next millenium.

Thus the forestry experts in government, industry, and academia, who came to RFF this past spring to pay their respects to Clawson also came to consider how the Forest Service can regain its vision and what its focus should be. What public forests will look like and what types of benefits they will offer future generations will depend a great deal on how the service shapes its management strategy over the next decade, speakers at the conference maintained.

The conference opened with remarks from **Robert Lewis**, deputy chief of research for the U.S. Forest Service, and Senior Fellow **Roger A. Sedjo**'s tribute to Clawson.

Over the course of the next two days, **Chris Wood**, who is special assistant to the chief of the Forest Service, provided an insider's overview of current activities. **Robert Nelson** of the University of Maryland addressed the role of science in public land management, and **Sally Fairfax** of the University of California–Berkeley described what might be applicable lessons from efforts to manage state and trust lands.

Clark Binkley, of the Hancock Timber Resources Group and a former dean of the faculty of forestry at the University of British Columbia, offered perspectives on forest management on public lands in Canada.



PATRICK DEASON PHOTOGRAPHY

Marion Clawson, senior fellow emeritus

Sedjo returned to the podium to examine the various political constituencies to which the Forest Service must answer and to share his own vision of what its management objectives should be. Likewise, former chief Thomas presented his thoughts on how the service might function better in an increasingly complex operating environment.

President of Pinchot Institute **Al Sample** closed the meeting by urging the eighty participants to look forward to the next decade as a period of innovation. If there was a parting consensus, it was that the U.S. Forest Service will operate in the years to come under a very different mandate and management strategy than it has over the past century.

Some of the scholarly papers presented at the conference are now available as part of RFF's Discussion Paper series. The full collection will be published as a book in memory of Marion Clawson later this year.

View and download selected conference papers at www.rff.org. or order individual hard copies through RFF (see page 18).

The unkindest cuts

When it comes to making an environmental difference in forestry, "to log or not to log" is not the real question, Senior Fellow **Roger A. Sedjo** told the International Trade Commission in May. In an industry gone global, the apter question is "where to log?"

Reducing the timber harvest in the Pacific Northwest, for

GOINGS ON

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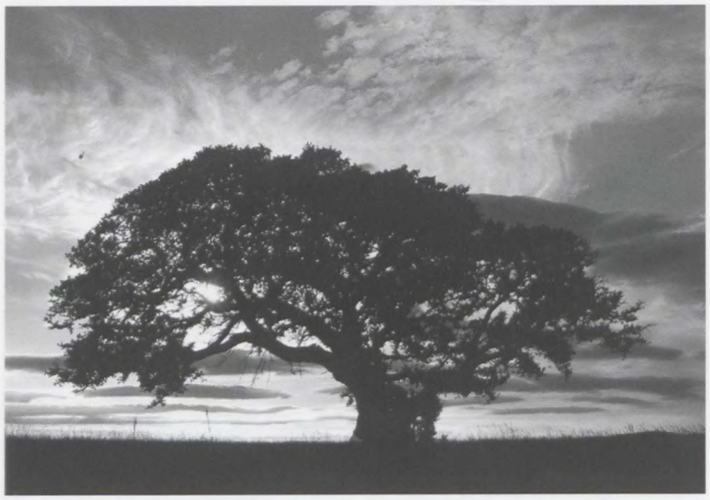


example, has not meant that fewer trees are cut down but only that logging has shifted elsewhere, Sedjo said in his testimony before the ITC hearing on "Conditions of Competition in U.S. Forest Products Trade." Similarly, he argued, if U.S. producers are impeded from selling to Japan, that country will simply go elsewhere to fill its huge appetite for wood products.

The Japanese, who currently import about 80 percent of their timber, would have to draw more on the forests of Malaysia, Indonesia, and Southeast Asia, among others. The environmental damage, Sedjo contended, would be substantially greater than if the wood were harvested in the United States.

Not only are U.S. logging and reforestation practices among the best in the world, he maintained, but old growth here is now protected—something that is not the case in many logging locations. U.S. wood products are also originating more and more from second-growth and plantation forests, he said, where the damage to biodiversity is minimal.

Most significantly, Sedjo told the commission, the U.S. forestry industry is poised to shift most of its harvesting activity into plantation forests. These high-yielding, biotechnologically sophisticated stands hold out the environmentally friendly promise of requiring far less land to produce.

Sedjo and his colleague **Dan Botkin** estimate that an area equal to 5–10 percent of the world's current forest land could easily produce all of the world's industrial wood needs, if properly managed. If so, the remaining 90–95 percent could be converted to other purposes, including conservation and recreation.

But restrictions on industry trade might well wreck the chances of such plantations succeeding, Sedjo warned. Regions that specialized in this form of wood production would need to be able to export freely to the rest of the world.

In offering his testimony Sedjo, who directs RFF's Forest Economics and Policy Program, emphasized that his remarks reflected his personal views and not RFF's.

A lesson before drowning

One of the largest natural teak forests in Thailand may soon be inundated as a result of dam construction. Meanwhile, researchers from RFF and Thai universities are attempting to identify and quantify some of the forest's most elusive economic values.

In a special seminar at RFF in June, **Suthawan Sathirathai** of Bangkok's Chulalongkorn University joined **R. David Simpson** and **Roger A. Sedjo** to present an overview of the collaborative research that they have been engaged in since spring 1997 with support from the government of Thailand and the Ford Foundation.

The aim of the project, the three explained, is to quantify ecological impacts of the proposed Kaeng Sua Ten dam in economic terms, something that was not done in earlier studies of the project. The dam, which would supply water primarily for irrigation, would flood some 65 square kilometers of the Mae Yom National Park where the forest is situated.

In developing a common measure for both ecological losses and material benefits, the researchers hope to eventually arrive at a methodology that might be applied elsewhere in Southeast Asia, where a number of similar projects are under consideration.

At the seminar, the researchers described their assessments of three sources of value not investigated until now. They include the genetic diversity in teak genes, which might contribute to the health and variety of future trees in commercial plantations; nontimber forest products, such as mushrooms and bamboo shoots, collected by local people; and the forest's capacity to sequester carbon, which is thought to contribute to global warming.

Other members of the research team in Thailand are considering the value of the forest as a recreation spot and ecotourist attraction, and its cultural value to Thai citizens.

Among their preliminary findings the researchers cited the role of nontimber forest product collection—the gathering of mushrooms, bamboo shoots, and the like—in providing a form of "insurance" to local people. These products provide alternatives to wage labor and agricultural earnings, which are vulnerable both to natural disruptions and the types of economic disturbances that Thailand has experienced recently.

Overall, the study documents that important values have been ignored in previous work, and should be considered before a final decision is made on the dam project.

Cheap gas in cars may mean more gas in air

Over the past three decades the United States has involuntarily become a huge economic laboratory, demonstrating the tight relationship between energy prices and consumption. When prices go up consumption falls, and vice versa.

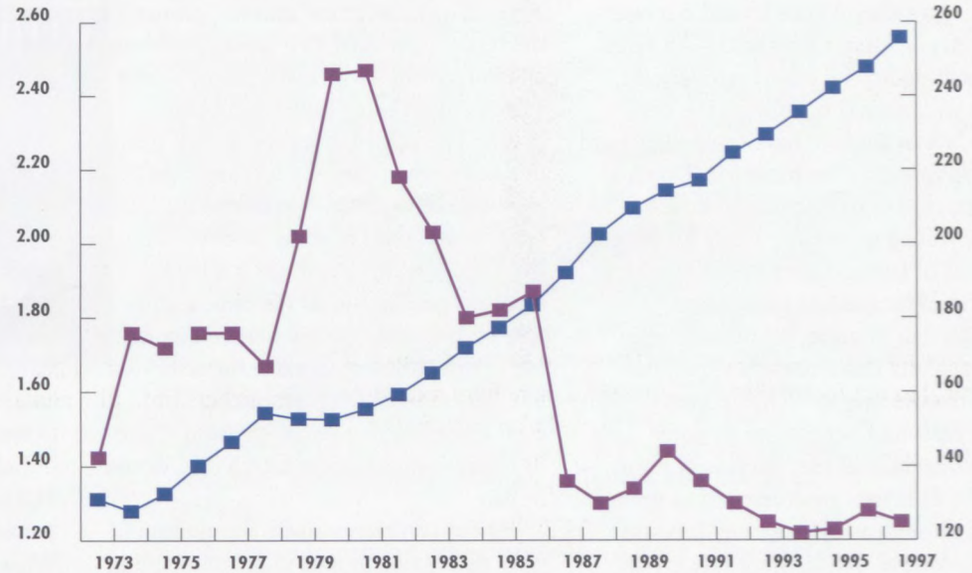
Gasoline prices in the United States fell this past winter to their lowest level ever, adjusted for inflation. For consumers, of course, it's welcome news. But the resulting increase in driving will make it more difficult than ever for the United States to reduce its emissions of the greenhouse gases that contribute to cause global warming.

At the beginning of March, the average price of a gallon of regular grade gasoline, taxes included, was 91.3 cents, according to the government's Energy Information Administration. That was 12 cents less than a year earlier.

At the trough of the Depression in 1933, the average cost of a gallon of regular gasoline in this country was 18 cents, the American Petroleum Institute's historical data show. Adjusted for inflation, that's the equivalent of $2.29 a gallon in today's dollars. In 1948, during the first postwar recession, the average price was 26 cents, or $1.77 in today's dollars. Although prices have risen since last winter, there appears to be no point in the past when the real price of gasoline was nearly as low as at present.

Facts for Thought

An occasional presentation of data about energy, natural resources, the economy, and the environment.



Gas and Go

U.S. Gasoline Prices* and vehicle miles traveled, 1973–97

U.S. average price (dollars per gallon, in 1998 dollars)

Total U.S. distance traveled in ten-billion vehicle miles

Source: U.S. Energy Information Administration

*prices before 1976 are for leaded gasoline

The combination of falling prices, strong economic growth, and rising incomes has had a powerful effect on gasoline sales. In January, the API estimated that gasoline consumption in this country has been increasing recently at a rate of about 3 percent a year—twice the trend in the 1990s until now. That is a conservative estimate, since the EIA's figures show that in mid-February the industry was supplying 4.3 percent more gasoline to the market than a year earlier.

Energy efficiency, meanwhile, has been a casualty of cheap gas. The fuel efficiency of the average automobile on the road rose steadily from 13.4 miles to the gallon in 1973 to 21.5 in 1997, according to the EIA. But even though the cars got better gas mileage, people drove each car slightly fewer miles per year when gas prices were rising. With prices falling, though, each car traveled nearly one-fourth farther in 1997 than it did in 1986. More important, there are now a great many more cars.

Since the census year 1970, the American population has increased by one-third. But the number of motor vehicles on the road—cars, trucks, buses, motorcycles, and all—has nearly doubled.

This synopsis is adopted from J.W. Anderson's "Do Cheap Gas Prices Undermine U.S. Climate Policy?" at *http://www.weathervane.rff.org*.

Time and Money

Discounting's Problematic Allure

by Paul R. Portney

Acting now to deal with problems whose consequences may not be felt for generations is obviously tricky business. The costs and benefits involved are hard to gauge, since they will be spread out over hundreds—perhaps thousands—of years. Still, waiting for the added certainty the future will bring is not always the best policy; sometimes we have to swallow hard and take preventative measures. Doing so, however, forces us to confront how much we are willing to sacrifice today for benefits that will be enjoyed later in our lives or in the lives of succeeding generations.

With that in mind, economists and other analysts make use of a technique called discounting to compare present with future costs and benefits on an equal basis. In its conventional use, streams of future benefits and costs are converted to present values through an appropriate discount rate. As long as the discount rate is positive, one dollar tomorrow is worth less than one dollar today. Take, for example, a project that twelve years from today will yield a return of $200,000. At an annual discount rate of 6 percent (reflecting, for instance, the cost of borrowing money this year versus next) that amount is now worth $100,000—all that an economist would advise investing.

To ponder whether and how to use discounting over much longer time spans, RFF and the Energy Modeling Forum at Stanford University invited the most influential thinkers on discounting to convene at RFF in November 1996. (During the energy crisis in the 1970s, RFF hosted a similar conference and invited some of the same participants, including Robert Lind. Out of that meeting arose Lind's crystallization of a prescription for the proper discount rate, around which a consensus lasted for some time.) Each of these economists wrote an essay in response to a set of questions eliciting their opinions on how best to use discounting in decisionmaking for the far future. Their varied points of view are now available in book form. (To order a copy, see page 18.)

A New Book

Though quite technical and no "primer," the recently released RFF book *Discounting and Intergenerational Equity* plainly shows agreement on some broad and basic points. The contributors speak with nearly one voice when they say it is appropriate—indeed essential—to discount future benefits and costs at some positive rate. Even those authors who favor a lower discount rate for the far (as opposed to near) future quite clearly believe that failing to discount would make for poor intergenerational decisionmaking. And even those few that could envision a zero or negative rate suggest such a case would be rare.

At the conference itself, the authors were nearly unanimous in recommending the use of a standard procedure for evaluating projects with timeframes of forty years or less. Within the scope of this relatively short period of time, they generally embraced discounting benefits and costs to make present-value comparisons. What's more, they tended to think the discount rate should reflect the opportunity cost of capital. Beyond the forty-year mark, however, discomfort set in, as the essays reveal.

Clouds in the Crystal Ball

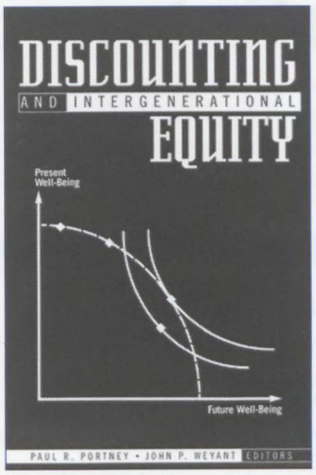
To read the new RFF book is to get a sense of the unease among the best minds in the profession about the technical complexity and ethical ramifications of discounting far into the future. For one thing, there is no mistaking the very small present value of even very large costs and benefits if they will not be realized for hundreds of years.

Assume, for example, that the gross domestic product of the world will be $8 quadrillion in the year 2200 in current dollars. (This assumption is consistent with an annual growth rate of 3 percent from current world GDP over the next two hundred years.) Suppose next that we want to calculate the present value of that sum using the 7 percent discount rate that the Office of Management and Budget recommends for such purposes. The answer we get is a surprising $10 *billion*. In other words, it would not make sense for the world's present inhabitants to spend more than $10 billion today (or about $2 per person) on a measure that would prevent the loss of the entire GDP of the world two hundred years from now.

That conclusion may seem stunning. Yet the reason is clear enough: We could invest that same $10 billion at 7 percent today and have a sum more than sufficient to replace GDP two centuries ahead.

Still, what guarantee is there that the $10 billion invested would remain untouched during the intervening years? What if, instead, people living a century from now decided to dip into the fund to finance their own consumption? Those living two centuries from now would be left with neither the problem-mitigation project we eschewed nor the fund we created to make them whole.

Another difficulty that discounting the distant future presents is choosing between economic efficiency and distributional equity—and being able to tell the difference. Although the contributors to the RFF book are not among them, some people that are uncomfortable with the distributional consequences of climate change seem eager to tinker with the discount rate to make mitigation policies pass the efficiency test (when in fact they may not). There is no need to do so—efficiency is hardly the only criterion that matters in policy analysis. If, for example, it would be more efficient to reject a climate protection program, say, because it would be cheaper to invest the money in an interest-bearing asset, we might opt for the program, anyway, out of concern for the welfare of our descendants, especially



Discounting and Intergenerational Equity

Edited by Paul R. Portney and John P. Weyant
With a foreword by Robert M. Solow

The effects of decisions made today about many environmental policies—including climate change and nuclear waste—will be felt across hundreds, if not thousands, of years. In the case of issues with such long-term ramifications, analysts often employ discount rates to compare present and future costs and benefits.

In this landmark book, Paul Portney and John Weyant have assembled some of the world's foremost economists to reconsider the purpose, ethical implications, and application of discounting in light of recent research and current policy concerns.

Contributors include Kenneth J. Arrow, Scott Barrett, David F. Bradford, William R. Cline, Maureen Cropper, Shantayanan Devarajan, Partha Dasgupta, Raymond J. Kopp, David Laibson, Robert C. Lind, Karl-Göran Mäler, Alan S. Manne, W. David Montgomery, William D. Nordhaus, Jerome Rothenberg, Thomas C. Schelling, V. Kerry Smith, Michael A. Toman, and Martin L. Weitzman.

Paul R. Portney is president of RFF, where he is a senior fellow. John P. Weyant is director of the Energy Modeling Forum and professor in the Department of Engineering–Economic Systems at Stanford University.

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if we doubt that compensation for now ignoring the problem will be available to future generations.

An Array of Approaches

Some of the book's contributors suggest using different discount rates depending on the period over which net present values are being tallied. This possibility of *nonconstant* discounting has surfaced in a growing number of studies, which show rather consistently that while individuals do appear to attach lower weights to distant benefits, they do not use a constant exponential discount rate. Rather, the longer the time period before effects are felt, the lower the implicit discount rate used.

Perhaps most surprisingly, at least three of the authors question the very utility of standard benefit-cost analysis for problems with significant intergenerational consequences. Thomas Schelling suggests, for instance, that we view the problem of climate change in much the same way that we try to decide the right amount of foreign aid to make available to poorer countries each year.

In an altogether different approach, Raymond Kopp and I suggest a mock referendum. The idea is to elicit from members of the present generation their willingness to pay to reduce both present and future risks associated with climate change. An aggregate willingness to pay would then be compared with the expected costs, say, of climate change mitigation. This approach would circumvent the need to estimate very long-term streams of benefits and costs, as well as the need to choose an appropriate discount rate. But it does present its own problems, such as how to frame and ask the questions to elicit honest responses.

A Fair Future

In the seventies, the energy crisis led people outside academia to think hard about the comparison of benefits and costs across time. Today it is the climate change debate that is largely responsible for reawakening interest in the subject, since it forces us to think about the legacy we may be leaving future generations. As soon as we begin to consider policies to affect the latter, up pops the concept of discounting. If a latter-day consensus on how to use this tool is not in the offing, it is perhaps toward another kind of workability that the essays in the new RFF volume can begin to lead: by clarifying what exactly is being debated and why it is important.

Paul R. Portney is president of Resources for the Future. This article is based on the introduction, which he and John P. Weyant wrote, to *Discounting and Intergenerational Equity*, the new RFF book they edited.

Carving Out Some Space

A Guide to Land Preservation Strategies

by James Boyd, Kathryn Caballero, and R. David Simpson

The legal instruments we use to conserve habitat are still evolving. Continuing experimentation is needed, if we are to save more land at less cost. Meanwhile, the many conservation easements that have sprung up nationwide let us see how well some instruments are working.

In the years ahead, demographic and economic changes should fuel pressure for more land development in this country. In turn, the growing scarcity of natural habitats will increase the social value of preservation. Thus the need is growing for policies and institutions that can balance the requirements of economic development with the benefits of species, habitat, and open-space conservation.

If the challenge is balance, regulation does not look promising for the purpose. Many interested parties view the law as an "extreme" option that does a relatively poor job of weighing competing interests. Under the current version of the Endangered Species Act, for example, animal and plant species threatened by changes in land use are designated public trust resources, but most of the land on which they live is not. It is rather as if Solomon went ahead and cut the baby in two: neither wildlife conservationists nor private developers are satisfied with the result.

Alternatively, "market-based" incentives to motivate conservation are gaining favor. These incentives include full- and partial-interest land purchases, tax-based incentives, and tradable or bankable development rights. The key to their attraction lies in compensating private owners for putting restrictions on the use of their land for public benefit.

The Costs of Habitat Conservation

We can divide the costs of implementing any conservation policy between *transaction* and *opportunity* costs. The transaction cost is the amount of time, money, and effort needed to establish, monitor, and enforce such a policy. The opportunity cost is the difference between the value of land in its "highest and best" private use and its value when employed in ways compatible with conservation.

No policy can avoid the cost of foregone development. What may appear to be striking differences in the costs of alternative policies are actually differences in *who* bears the cost of conservation. While who deserves to pay will always be a subject of political debate, the cost itself cannot be avoided. Any policy that appears to provide for conservation without full compensation for the land's lost use for other gainful purposes is one whose costs are hidden, or one that will not be effective.

The fact that the opportunity cost of foregone development cannot be avoided does not mean that all conservation policies are equivalent, of course. From an implementation standpoint, and in terms of likely effectiveness, there are important differences. One way to organize an analysis of these differences is to focus on the institutions and actions necessary to implement the policies in the real world.

Such an analysis reveals differences in the information required by agencies, the types and difficulty of enforcement, and the structure—all of which add up to the transaction costs of a given conservation plan. The notions of opportunity and transaction costs can be used to characterize alternative approaches to habi-

tat conservation, a number of which are described briefly below. Because of its relatively active use, we save our description of a conservation easement for last and devote the rest of this article to its discussion.

Purchase of full property interests. A "fee-simple" acquisition for conservation purposes requires a purchaser to pay the full value of the seller's use of the land. This arrangement can result in "overkill" if, for example, the price includes the value of agricultural or low-intensity activities that are actually compatible with conservation. On the other hand, purchase of full ownership obviates the need to specify future management practices and engage in the expensive monitoring of other approaches.

Tax credits and penalties. Another way to keep land out of development is for the government to give owners tax credits or other subsidies for doing so. Tax-based incentives result in at least some of the opportunity costs of conservation being shared among other taxpayers, who must either make up the revenue shortfall resulting from conservation-related tax breaks or make do with fewer public services.

Private landowners have an incentive to overrepresent the value of the lands they devote to conservation, to the extent that they receive tax breaks for doing so. However, the tax system typically "underrewards" conservation donors. Because tax codes require payment of something less than the entire amount of income or value of property, relief from this tax payment incompletely compensates the donor for the claimed value of the donation. Tax-based conservation incentives also require monitoring in order to confirm that the taxpayer is maintaining the land.

Offering tax-based incentives is generally less effective than acquiring particular properties. The decision to make tax-deductible donations is a voluntary one, and it is generally impossible to predict exactly which landowners eligible to make such donations will choose to do so.

Tradable development rights. A tradable development rights (TDRs) program distributes "rights" to some fraction of the land in an area. Anyone who wishes to develop land in excess of the amount of TDRs he owns must purchase additional rights. The opportunity cost of these programs is minimized because the land set aside for conservation is also the land with the least value for alternative uses. Transaction costs may be low to the extent that private markets in TDRs work relatively efficiently, but the need to monitor and enforce preservation requirements on lands for which TDRs have not been issued remains. In addition, TDRs are similar to tax-based incentives in that one typically cannot know in advance which lands will be preserved.

Regulation. Regulation that prohibits development may appear to be costless at first glance; when land use restrictions are imposed by regulation, no payments or subsidies are made to landowners. Nevertheless, regulation deprives a landowner of the

Anatomy of An Easement

While the conservation easement contracts we reviewed exhibited a fair degree of variability, most shared a basic set of characteristics.

- A description of the subject property, its ecological conditions and known environmental hazards, and a broad "statement of purpose";
- An agreement by the owner to submit the land to an environmental assessment, identify and correct any encroachments, and identify and remove disamenities;
- A limitation on the owner's ability to develop the land or alter its existing uses, and a description of the land uses that are allowed;
- An agreement by the owner to meet certain standards in management of the property;
- A right granted to the conservator to enter the property to ensure through observation that the contract is being honored;
- A demonstration by the grantor that the property has no liens attached to it;
- Provisions for adjudication or arbitration in the event of an alleged breach of contract;
- Indemnification of the conservator against liabilities associated with the property;
- Application of the easement to all subsequent owners of the property (often, the conservator must be given right of first refusal if the property is sold); and
- A number of provisions that set out responsibilities, deadlines, and payments associated with the original easement sale itself.

What's An Easement Worth?

Unlike sales of full interests in property, easements are still relatively rare. Moreover, the particulars of each easement are unique. Thus, no typical "market price" exists on which to base tax deductions. To avoid fraud, tax authorities allow deductions only for donations of land made to bona fide conservation organizations. Regulations on appraisers and penalties for excessive appraisals also constrain abuses. Still, overappraisal can be difficult to prove. The Federal Tax Code penalizes excessive donations only if the appraisal is off by more than 100 percent.

Typically, easement valuations range from 20 percent of the land's estimated total value to upwards of 90 percent. The Florida easements purchased by the state water management districts range in value from 28 to 60 percent of the properties' total value.

opportunity to earn income from future development. It is for this reason that many consider such regulations to be "takings" of property. Like the other options, regulation entails monitoring and enforcement costs. Unlike TDRs and tax incentives, however, it has the virtue of being able to target specific habitat types. In fact, regulation may seem to be a particularly efficient way of approaching conservation, since it eliminates the need for intervening institutions such as markets or tax assessment and collection. The specificity of regulation can also be its greatest drawback, however. The involuntary and information-constrained nature of regulation means that the properties whose opportunity costs are the lowest will not necessarily be selected.

Purchase of a conservation easement. In exchange for payment (or a tax deduction) a purchaser receives assurances that a landowner will not develop designated land any further. Since a conservation easement involves the purchase of a "partial interest" in the land, it is less expensive than acquiring fee-simple ownership. On the other hand, easements involve substantial transaction costs, both in writing a contract and in subsequently monitoring and enforcing it.

Conservation Easements

Considerable recent experimentation with conservation easements has afforded us an opportunity to see how such incentives work in practice. Thus, we have looked at a number of easement contracts in order to identify their common features, evaluate their effectiveness, and make suggestions for their improvement. Numerous conservation organizations and public agencies are currently engaged in easement acquisitions nationwide. More than thirty states have passed legislation specifically sanctioning conservation easements for conservation, scenic, or historic purposes.

Easements possess several advantages. First, partial interest in a piece of land is less costly to acquire than full ownership. Second, compared with conservation tax incentives or tradable development rights, easements entail few new administrative burdens. Third, they necessitate few, if any, changes in environmental and property statutes. Finally, because they involve voluntary transactions, easements are more politically palatable than direct land use regulation.

Easements do present challenges, however. The money saved upfront in acquisition costs must be balanced against the higher, long-term costs associated with monitoring and enforcing the division of ownership rights between the primary landowner and the conservator (the owner of the easement). While these costs can, to an extent, be anticipated and reduced by drafting an enlightened initial contract, the process of contracting itself thus becomes more expensive.

We have assessed a number of easement contracts in the state of Florida. These agreements were signed between landowners and Florida Water Management Districts (WMDs) or the Nature Conservancy (TNC). While a couple of the TNC contracts were completed more than ten years ago, the rest are of more recent vintage and signify the emergence of easements as a conservation tool in Florida. The properties concerned are dispersed throughout the state and are relatively large in size, in some cases encompassing over ten thousand acres.

Several aspects of these easement contracts are worth noting. First, they tend to be perpetual. Why? One reason is that bargaining for contract terms is costly. A short-term contract implies frequent bargain-

ing (every time the contract expires) whereas a perpetual contract minimizes the activity. Balanced against a desire to avoid the costs of repetitive bargaining may be a desire to retain flexibility. Many contracts contain terms regarding their own termination.

Our review of the Florida easement contracts revealed many "optimal" characteristics. In the economic theory of contracting, the party that can best prevent or ensure against risks should be required to do so. In the cases that we looked at, that party was the landowner, who was responsible for two basic contingencies in the easement contracts. The first was degradation in a property's ecological condition, over which a landowner has the most direct control.

The second contingency consisted of pre-existing liabilities attached to the property, the most prominent examples being delinquent tax payments and environmental contamination. Once again, responsibility for these problems lay with the landowner, who was better positioned to anticipate and remedy them than was the conservator. The easement contracts acknowledged this ownership of responsibility by indemnifying conservators against such liabilities.

In addition, the review of the records showed that a property owner is typically required to conduct an environmental audit prior to transfer of the easement, to make a representation that the property is free of contamination sources such as leaking storage tanks, and to ensure that title to the property is free of any liens or encumbrances.

Of course contracts are never able to define every possible future contingency. The costs of identifying and allocating responsibility across a "complete" set of circumstances are prohibitive. For this reason, contracts often rely on underlying principles of law, precedent, or community custom to define what is acceptable. In the absence of explicit contract terms, it is left to the courts to decide whether or not a contract breach has occurred and to specify damages if one has.

How Should Properties Be Managed?

It is difficult to specify how easements to protect wildlife habitat should be managed. Easement contracts often call instead for standard Best Management Practices (BMPs) usually approved by federal or state organizations. Other contracts refer to a more general "duty of care." Unlike BMPs, such a duty has not been well defined. However, examples do exist, such as those pertaining to land management in the 1976 Federal Land Policy Management Act.

The Need for Experimentation

Public support for, and increased government involvement in, land conservation initiatives call for an analysis of alternative preservation policies. Each of the alternatives raises a set of legal, institutional, and economic issues. Experimentation with these alternatives is essential if the greatest possible benefit is to be realized from scarce conservation dollars.

All land use policies are not alike, differing in the way in which they ensure conservation, the complexity of their execution, and their costs. Preferences for one policy over another must be rooted in the merits of implementation.

Conservation instruments are evolving toward accomplishing their objectives more efficiently, but continuing experimentation with innovative instruments will facilitate the goal of achieving more conservation at less cost.

James Boyd and R. David Simpson are fellows in RFF's Energy and Natural Resources Division. Kathryn Caballero is a 1999 graduate of New York University School of Law.
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Saving the Trees by Helping the Poor

A Look at Small Producers along Brazil's Transamazon Highway

by Charles Wood and Robert Walker

Over the long run, conserving tropical forests will depend on finding complementary ways of meeting the needs of the rural poor. Title to land will help, especially if freedom from eviction is boosted by freedom from fire.

The inexorable drive of subsistence farmers to clear tropical forest for an eked-out living presents a major environmental threat, nowhere more than in the frontier areas of Brazil where the rate of deforestation is among the highest in the world. Government responses have taken a number of forms, including setting land aside in nature preserves.

Desirable as this approach may seem, policies to establish conservation forests often founder on the *social* problem of rural poverty. Although small holders and shifting cultivators can be kept out of well-protected areas, on a regional scale it is unrealistic to assume that enforcement could ever be entirely effective. Apart from the high cost of monitoring large tracts of land, there remains the moral issue of depriving communities of needed land for agriculture. Large-scale enterprises that might create jobs for the rural poor while alleviating pressure on forest resources sound good in theory, but settlement frontiers offer few locational advantages for large-scale capital investments. The approach of greatest social viability, at least in the short run, is to create incentives for farming in ways that conserve natural resources.

Resource economists have long argued that subsistence farmers are more likely to conserve if they can establish property rights that guarantee legal ownership of land. Only then can they be sure of reaping the benefits of restraint and investment. Throughout the world such security is often viewed as synonymous with the receipt of land *title*, a legal document conferred by government agencies or obtained through sales transactions.

Conversely, these economists maintain, farmers without secure title are more likely to opt for immediate consumption over long-term investment. They tend to rapidly exploit land and timber resources rather than engage in sustainable production strategies.

Conserving Nature for Profit

If advocating property rights for purposes of conservation has enjoyed something of a renaissance over the past twenty years, resource economists have only recently expanded the concept to include wealth creation and economic development more generally. They point out that having no title to land *and* being poor encourages rural people not only to clear forest

but to mine soil nutrients, an agricultural practice that rapidly exhausts soil fertility and degrades its structure.

By contrast, the economists say, freedom from eviction and the rights of individuals to monopolize land not only for personal consumption but for profit are powerful stimuli to economic activity and investment. The result can be conservation of valuable soils and timber resources. Granted, physical growth rates of commercial hardwoods are probably too slow to protect them from liquidation by individuals intent on short-term profit maximization. But where long-term investments are likely to pay off, conservation is bound to benefit. A farmer whose title to land is secure may, for example, leave a forest bequest to children. A relatively predictable future also lessens the need to clear noncommercial trees so as to make *de facto* claims on agricultural plots.

Although the theoretical reasoning that leads to these conclusions is cogent, in fact the predictions have rarely been subjected to empirical test, especially in rural Brazil. Thus, we participated in the study described later in this article whose results provide empirical support for theory.

Elsewhere, studies in Thailand and Africa are beginning to substantiate beneficial soil conservation effects related to land tenure security. A rise in secure property rights among poor farmers is expected to bring about land improvements, and the switch to farming systems based on perennials or tree crops that are much less consumptive of soil nutrients. (See "Further Reading," page 17.)

Networking to Fight Fire

Whether deforestation can be slowed depends, then, on whether mitigation makes sense economically at the individual farm level. However, even where it does make sense, the forest resource base still faces substantial threats from outside forces over which the farmer profiting from conservation exercises no control.

Fire is a particularly acute threat, as recent events in Indonesia, Mexico, and Brazil dramatically underscore. In northern Brazil, one million hectares of forest burned in early 1998 before the onset of the rainy season. It was the first time in recorded history that an extensive area of forest closed to development burned in Amazonia. Drought conditions associated with El Niño, and possibly exacerbated by greenhouse gas buildup, will in all likelihood continue to bring

The research team interviewed hundreds of poor farmers in the Brazilian state of Para to learn which communities were organized to prevent the spread of fire.

the moist forest of the Amazon Basin to the point of flammability.

The fire threat that drought poses makes the prevailing land use and agricultural practices of Amazonia all the more a concern.

New studies of the effects of "surface" fires used to facilitate selective logging in the Amazon show that the measures of deforestation that we have come to rely on as environmental indicators vastly underestimate the magnitude of the damage done. In particular, surface fires unleash a cycle of increasing flammability and forest degradation, with effects that do not become visible on satellite images for years.

Research by Dan Nepstad and his colleagues calls attention to the previously unnoticed effects of these fires. Once out of control, they escape into standing primary or logged forest. While they burn with less

Titling Status of Survey Lots on the Transamazon Highway

	Universe	Titled Lots	Provisional Title Type	
			Authorization	Recognition
Untitled	145 (42%)			
Titled	202 (58%)			
Definitive Title		135 (67%)		
Provisional Title		67 (33%)	45	21

Note: Title is definitive when a government document is in evidence. Provisional title is a step toward definitive title, and is indicated by the possession of an "authorization" or a "recognition" by the titling agency. Of the 67 provisional titles, 1 did not report provisional title type.

intensity than the fires associated with agricultural use, surface fires nonetheless cause severe damage to the understory, and to tree species with fire-sensitive outer barks. Because they are slow-burning, surface fires also ignite a vicious positive-feedback effect by increasing the subsequent flammability of the landscape. Thus far, these surface fires have affected one and a half times more forest than the fires that small farmers set.

Still, these latter "deforestation" fires can be contagious. Initially, farmers set them to clear land for planting, usually of rice and pasture. Later, they set them as part of the crop rotation process and to clear secondary growth. Farmers also burn pastures to keep out invasive plant species.

One response to the threat of spreading fire that these agricultural practices pose might be to consolidate individual land parcels into large farms. Unfortunately, however, such an approach flies in the face of other objectives, such as alleviating rural poverty through land reform, a pressing concern in Brazil, and one that calls for more land parcels, not fewer. Thus, alternatives must be sought.

As recent research in Brazil shows, institutions do exist to promote cooperative relations between small holders in forest frontiers. These community organizations with local bases of participation facilitate access to financial credit, ensure reasonable prices for raw resources and finished goods, and provide a political voice for poor farmers. They also provide a forum for farmers to unite against the spread of fire.

Interviewing in the Amazon

To better understand the connections among land tenure security, logging, and fire contagion, researchers at the University of Florida, Florida State University, and the Brazilian Agricultural Research Agency (EMBRAPA/CPATU) undertook a collaborative study among poor farmers in the Brazilian Amazon. The research team conducted interviews with 261 small producers on the Transamazon Highway, whose land possessions covered 347 lots of 100 hectares each, the original size of land grants to families in a colonization project that began with the highway's construction in the 1970s. The hope of the colonization scheme was to settle an empty region, thereby "bringing people without land to land without people."

Among other things, the interviews allowed us to collect extensive information on the farming households themselves, their farming systems, and their use of the forest. We also were able to obtain the land titling status of the individual lots (see the table).

In addition to the survey of properties, we interviewed individuals involved in the region's political organizations, such as the rural union, a number of cooperatives, and several other groups that facilitate access to financial credit. On the basis of these interviews, we were able to determine which communities within the study area were well organized to prevent the spread of fire and which ones were not. It was the research team's hypothesis that social ties among farmers would create a basis for both the formal and informal regulation of fires during the burning season.

Statistical results from the research show that having title to land does indeed influence the way that small land holders manage tropical hardwoods. In particular, possession of title encouraged the long-term maintenance of valuable wood and reforestation activities. Results from logistic regression show that the frequency of forest conservation and reforestation was much higher among individuals with title than without, even after controlling for important determinants of land use such as family size and availability of economic resources. Indeed, the relative frequency of reforestation among those with title was about fifteen times higher than among those without.

Likewise, possession of a title tended to discourage participation in timber markets. Although the statisti-

cal effect was not as strong as observed for forest conservation and reforestation, poor farmers holding title to land were less likely to have recently sold trees than those without title. The research findings thus offer empirical support for the predictions derived from the property rights paradigm.

With respect to fire contagion, the results are more complex. When the probability is high that fires will spread from one property to another, the very kind of security presumably afforded by property rights is eroded. The possession of title, and the associated right to do with a piece of property as one sees fit, provide no protection against the economic behavior of one's neighbors.

Results from logistic regression show that possession of land title did not lower the risk of damage caused by a neighbor's activity. The relative frequency of individuals experiencing fire contagion was about the same among individuals with and without title.

What appeared to make some difference, however, was whether the property was located in a well-organized part of the study area. Lots located in the vicinity of an effective credit organization, cooperative, or union representative tended to suffer less fire contagion than lots found in unorganized areas. The relative frequency of fire in a well-organized area was about 60 percent lower than elsewhere.

Our argument is that organizational effectiveness creates community cooperation, which in turn provides household incentives to control and manage the use of fire. People in well-organized areas were found to work with their neighbors to take such preventive measures as constructing firebreaks, coordinating the timing of their burns, and generally keeping each other informed of their fire-related plans.

Setting Policy

Based on the research done to date, conserving tropical forests over the long run will require setting policies that effectively address the needs of the rural poor. Land tenure security associated with land titling is important in this regard, as it reduces the rate of hardwood depletion by small holders and encourages their efforts at reforestation.

It is important, however, to recognize that the notion of land tenure security extends beyond the right to private property. Findings from the Brazilian research suggest that another dimension of tenure security rights should be considered, namely the right to remain free from the damage caused by fire contagion.

Promoting land tenure security thus involves attention not only to land titling but to the development and support of social organizations that transform isolated farmers into civic partners.

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Charles Wood is Director of the Center for Latin American Studies at the University of Florida. Robert Walker is an associate professor in Michigan State University's Department of Geography. In 1997–98, Walker was in residence at RFF as a recipient of the Gilbert F. White Postdoctoral Fellowship.

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"Spring green" meeting for RFF Council

How will environmental advocacy play out in the next century? The question dominated discussion at the RFF Council's annual two-day meeting in April, where more than half a dozen organizations offered their thoughts. They included the Environmental Defense Fund, the National Wildlife Federation, the Natural Resources Defense Council, the Pew Charitable Trusts, the California Rural Legal Assistance Foundation, and the Sierra Club.

The RFF Board of Directors also held its regular spring meeting as part of the scheduled events and elected **Robert E. Grady** as its new vice chairman. Grady has served on the RFF Board since 1996.

The Board created the RFF Council in 1991 to recognize RFF donors and their interest in natural resource and environmental policy.

DAVID FARRIOR PHOTOGRAPHY

Dow Chemical VP Wilma Delaney and Enron Corporation Senior VP Steve Kean visit with Frank L. Matthews, his wife Joan, and Edward L. Strohbehn Jr (l to r). Delaney and Keen are RFF Council members. Matthews and Strohbehn are RFF board members.

New on board

Norman L. Christensen Jr. is the newest member of RFF's board. Christensen is Duke University's dean of the Nicholas School of the Environment.

A biologist, Christensen is also a professor of ecology at Duke, where he has had a long and distinguished career in teaching and research.

DUKE UNIVERSITY PHOTOGRAPHY

1999 award winners

Gilbert F. White Postdoctoral Program

Kathryn J. Harrison and **Kenneth A. Small** received this year's fellowships, named in honor of the retired RFF board chairman.

Harrison is an associate professor of political science at the University of British Columbia.

At RFF she will study the records of four countries to see whether they tend to relax environmental standards and their enforcement to attract new investment and retain existing industries, or if instead they seek to impress environmentally concerned voters and firms with stringent standards.

Small is a professor of economics at the University of California–Irvine with an interest in transportation and environmental issues.

At RFF he will be modeling and quantifying the effects on public mass transit that occur when it costs more to drive a car (say, because of new congestion fees or a gas tax).

DEVELOPMENT

RFF: Offering insight, information, and involvement

by Lesli A. Creedon

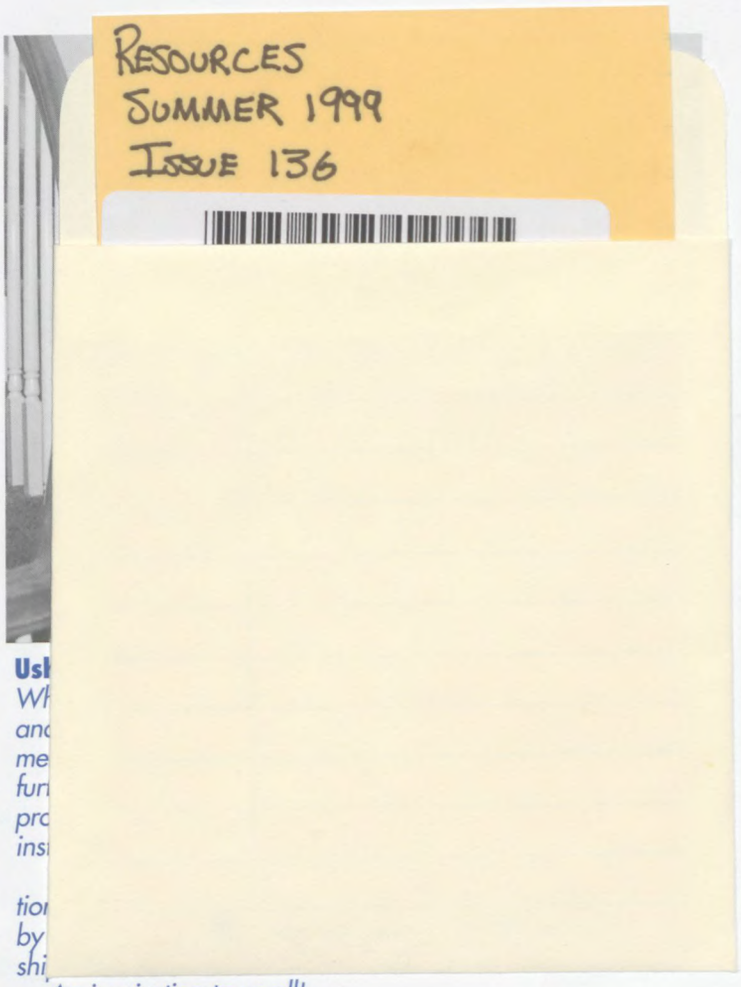
RFF depends on its many individual and corporate donors not only for vital financial support, but, more importantly, for their personal involvement in the institution. Through public conferences, the Wednesday Seminar Series, Council member forums, advisory committees, and one-on-one meetings, RFF's contributors gain insight into issues that concern them personally and professionally, as well as provide their unique perspective and advice to RFF scholars on current and future research initiatives. RFF promotes many opportunities to sustain this important interactive relationship, two of which are highlighted in this issue of *Resources*.

Electricity roundtable

In May, representatives from various electric utility companies and trade associations which support RFF met with scholars for a lively give-and-take discussion on current RFF research pertaining to the industry. Topics of discussion included the future regulation of electricity transmission and distribution, carbon mitigation opportunities in the electricity sector, appropriate policy toward nuclear power, and the performance of renewables. This forum gave RFF donors from the electricity sector an opportunity to contribute ideas to the research agenda as well as learn about research in progress or coming to completion.

Forest committee meeting

Also in May, members of the Forest Economics and Policy Program (FEPP) Advisory Committee met with Roger Sedjo, FEPP's director, and other RFF scholars to learn more about current projects on biodiversity, sequestration and global climate change, and global timber supply issues, including the impacts of biotechnology on forestry. The FEPP Advisory Committee is comprised of corporate executives, government officials, and environmental advocates and is RFF's longest standing advisory board. The committee continues to be one of the most active vehicles for RFF contributors to provide researchers with valuable feedback on the past and future direction of the institution's highly regarded forestry program.



An inspiration to us all!

Recent grants to RFF

Asian Development Bank—$85,000 to provide training to bank staff in Manila on emerging instruments for managing pollution and natural resources

Tinker Foundation—$100,000 to fund the RFF project "Controlling Pollution from Small-Scale Sources: Leather Tanneries in León, Mexico"

U.S. Department of Energy—$221,000 to assess the economic efficiency of various carbon trading schemes

U.S. Environmental Protection Agency—$78,000 to estimate the value people place on improving the quality of the Adirondack ecosystem

Weyerhauser Foundation—$50,000 for unrestricted general support

New RFF Council members

American Electric Power
Bridgestone/Firestone
Eastman Chemical
Edison International
Pacific Gas & Electric

Welcome and thank you

For more information on how you can become involved, please contact Lesli A. Creedon, director of development, at 202–328–5016; creedon@rff.org.

RESOURCES FOR THE FUTURE

The Interns of 1999

PATRICK DEASON PHOTOGRAPHY

Each year, RFF invites about a dozen students (mostly graduate students working on advanced degrees) to spend the summer here as research assistants. For some, the experience is the beginning of a long professional association, eventually leading to appointment as RFF fellows. Pictured here with RFF President Paul R. Portney (front row, center) are the interns of 1999.

***Back row (l to r)**: Kim Petrick, Cameron Speir, Brian Nadreau, David Evans, and Salvador Martinez. **Front**: Anne McEnany, Kellie Ortega, Rebecca White, and Grace Bai. **Not pictured**: Bentley Coffey, Melissa Manderschied, Stephen Newbold, Julio Videras, and Lubiao Zhang (He and Bai are Walter O. Spofford Jr Memorial interns).*

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