



SCHOOL OF LAW
TEXAS A & M UNIVERSITY

Texas A&M University School of Law
Texas A&M Law Scholarship

Faculty Scholarship

2003

Market Principles for Pesticides

Andrew P. Morriss

Texas A&M University School of Law, amorriss@law.tamu.edu

Roger E. Meiners

Follow this and additional works at: <https://scholarship.law.tamu.edu/facscholar>



Part of the [Law Commons](#)

Recommended Citation

Andrew P. Morriss & Roger E. Meiners, *Market Principles for Pesticides*, 28 Wm. & Mary Envtl. L. & Pol'y Rev. 35 (2003).

Available at: <https://scholarship.law.tamu.edu/facscholar/338>

This Article is brought to you for free and open access by Texas A&M Law Scholarship. It has been accepted for inclusion in Faculty Scholarship by an authorized administrator of Texas A&M Law Scholarship. For more information, please contact aretteen@law.tamu.edu.

MARKET PRINCIPLES FOR PESTICIDES

ANDREW P. MORRIS* & ROGER E. MEINERS†

I. Pesticide Use	39
II. Free Market Environmentalism	48
A. Market Incentives	49
B. Private Property	51
C. Paying for Damages	53
D. Subsidies	54
E. Summary	55
III. Four Alternative Pesticide Fables	56
A. Early Pesticides & Legislation	56
B. Subsidizing Spraying	65
C. DDT & Malaria	71
D. Drift	76
IV. Principles	83
V. Conclusion	86

Pesticide use is one of the great evils of the modern environmental movement.¹ Pesticides threatened a “Silent Spring” in Rachel Carson’s 1962 book of the same name² by removing song birds from American towns. Carson’s book was enormously influential—former Vice President Al Gore, for example, cited it as an important part of his environmental awakening in

* Galen J. Roush Professor of Business Law and Regulation, and Director, Center for Business Law and Regulation, Case Western Reserve University, and Senior Associate, Political Economy Research Center, Bozeman, Montana. A.B. 1981, Princeton; J.D., M. Pub. Aff. 1984, University of Texas at Austin; Ph.D. (Economics) 1994, Massachusetts Institute of Technology. Support from the Roe Foundation is gratefully acknowledged. Superb assistance with locating sources from Andrew Dorchak was indispensable.

† Professor of Law and Economics, University of Texas at Arlington, and Senior Associate, Political Economy Research Center, Bozeman, Montana. B.A. 1970, Washington State University; M.A., 1972, University of Arizona; Ph.D. (Economics) 1977, Virginia Polytechnic Institute; J.D. 1978, University of Miami.

¹ See BJØRN LOMBORG, *THE SKEPTICAL ENVIRONMENTALIST* 215 (Cambridge Univ. Press 2001) (1998) (“This message has been the legacy of Carson and has remained one of the major underpinnings of the environmental movement: our fear of chemicals.”); *id.* at 226 (reporting that “75 percent of all Americans are extremely concerned or very concerned about pesticides”).

² RACHEL CARSON, *SILENT SPRING* 103 (1962).

his campaign manifesto, *Earth in the Balance: Ecology and the Human Spirit*.³ The threat continues today: A "circle of poison"⁴ causes "workers, families, and communities" to be "slowly . . . poisoned by pesticides" in the developing world.⁵

Pesticide regulation was "reformed" in the aftermath of Carson's book, adding environmental considerations to the regulators' list of concerns and shifting regulatory power from the United States Department of Agriculture to the newly created Environmental Protection Agency ("EPA").⁶ EPA's 1972 final cancellation of DDT's United States registration was widely touted as a great victory for the environment.⁷ Environmental Defense, one of the major environmental pressure groups today, continues to tout its role in the DDT ban on its web site as an example of how citizen action can make a difference in policy.⁸

The new regime did produce major changes in regulatory behavior. Since 1972, EPA and pesticide manufacturers spent millions of dollars and years of effort to "re-register" most active ingredients under the new environment-friendly federal rules, canceling the registrations of some widely used chemicals and leading manufacturers to withdraw registrations on others.⁹ New international agreements extend the benefits of this regime to

³ AL GORE, *EARTH IN THE BALANCE: ECOLOGY AND THE HUMAN SPIRIT* 3 (1992) ("I particularly remember my mother's troubled response to Rachel Carson's classic book about DDT and pesticide abuse, *Silent Spring*, first published in 1962. . . . She emphasized to my sister and me that this book was different—and important.").

⁴ DAVID WEIR & MARK SHAPIRO, *CIRCLE OF POISON: PESTICIDES AND PEOPLE IN A HUNGRY WORLD* (1981).

⁵ James H. Colopy, *Poisoning the Developing World: The Exportation of Unregistered and Severely Restricted Pesticides from the United States*, 13 *UCLA J. ENVTL. L. & POL'Y* 167, 167 (1994/1995).

⁶ See Andrew P. Morriss, *Pesticides and Environmental Federalism: An Empirical and Qualitative Analysis of §24(c) Registrations*, in *ENVIRONMENTAL FEDERALISM* 137-45 (Terry L. Anderson & Peter J. Hill eds., 1997) (summarizing history of pesticide laws).

⁷ See, e.g., Jerry L. Anderson, *The Environmental Revolution at Twenty-Five*, 26 *RUTGERS L.J.* 395, 420-21 (1995) ("Taking DDT completely out of the stream of commerce has resulted in a tremendous improvement in environmental quality and species protection." (citation omitted)).

⁸ Environmental Defense still prominently features its work on DDT on its web site. See *ENVTL. DEFENSE, 2002 ANNUAL REPORT*, available at http://www.environmentaldefense.org/documents/2506_R2002.pdf (last visited Aug. 30, 2003).

⁹ WILLIAM H. RODGERS, JR., *ENVIRONMENTAL LAW* 480-87 (2d ed. 1994) (reviewing cancellations and other impacts of changes in registration to include environmental considerations); see also CHRISTOPHER J. BOSSO, *PESTICIDES AND POLITICS: THE LIFE CYCLE OF A PUBLIC ISSUE* 200 (1987); Morriss, *supra* note 6, at 144-45 (describing problems with registration and re-registration programs).

other countries, pushing bans on “persistent” pesticides elsewhere to complement the United States’ actions.¹⁰

This sounds like a successful example of a centralized command and control regulatory regime. And yet, there are reasons to doubt that central planning¹¹ produced success. Overall, pesticide use is growing in developing

¹⁰ See Erin Perkins, *The Stockholm Convention on Persistent Organic Pollutants: A Step Toward the Vision of Rachel Carson*, 2001 COLO. J. INT’L. ENVTL. L. & POL’Y 191, 191-92, 194-96, 197-99 (describing negotiation of Persistent Organic Pollutants (“POPs”) treaty).

¹¹ For a general discussion of central planning in the environmental context, see IAN WILLS, *ECONOMICS AND THE ENVIRONMENT: A SIGNALLING AND INCENTIVES APPROACH* 103-120 (1997). Farm programs generally fit this definition and environmental regulations have increased the central planning component. This can be seen in the increasingly mandatory nature of agricultural regulation. “During the past thirty years, federal regulation of the resources used in agriculture has shifted from giving technical and educational support to farmers to make voluntary decisions on conservation practices to imposing criminal penalties on farmers for carrying out what had been routine farm practices.” John K. Hosemann, *Agriculture and the Environment: A Thirty-Year Retrospective*, in *AGRICULTURAL POLICY AND THE ENVIRONMENT* 174 (Roger E. Meiners & Bruce Yandle eds., 2003).

Others might disagree with us that the Federal Insecticide, Fungicide, and Rodenticide Act (“FIFRA”) is a central planning regime, something we plan to address in detail in future work. Professor J. B. Ruhl, for example, a thoughtful critic of agriculture and the environment, writes:

In short, so long as the label instructions are followed, the applicator is properly certified and the applicator follows worker safety and recordkeeping requirements, FIFRA imposes no direct restrictions or requirements on farms. While this does not amount to a complete safe harbor for farm use of pesticides, FIFRA’s hands-off approach to farms—the primary users of pesticides—pales in comparison with the CAA’s and the CWA’s regulatory approach to their targeted industries. Under FIFRA, with regard to farmers, no permits are required, no environmental or efficiency performance standards are imposed, no technology-based standards are applied, no regular public reporting of pesticide applications is required, and no monitoring of pesticide levels in soils, runoff, or groundwater is required. Although some states regulate pesticide applications more aggressively than does FIFRA, it is fair to say that the nation has no comprehensive regulatory framework governing farm use of pesticides.

J.B. Ruhl, *The Environmental Law of Farms: 30 Years of Making a Mole Hill Out of a Mountain*, [2001] 31 *Envtl. L. Rep. (Envtl. L. Inst.)* 10,203, 10,215 (2001). Despite this laxity, we contend that FIFRA is central planning because it rests upon a regulator determining the products that may be applied to particular crops and the conditions under which those products may be used. EPA does not, however, tell manufacturers how much of each product to produce or dictate to farmers when they must apply particular products. That EPA has not adopted a planning regime that includes such details does not make what it does any less of a centrally planned regime. The debate between “market socialists” and market economists in the 1930s and 1940s over proposals to substitute planned economies that relied on markets for some aspects of decision making to solve technical planning problems established this. See FRIEDRICH A. HAYEK, *THE ROAD TO SERFDOM* (1944).

countries.¹² United States' pesticide use changed in content, but remains substantial in volume.¹³ Critics of pesticide policy, including many of the speakers at this symposium, are concerned that pesticide problems are worsening.¹⁴ Surprisingly, thirty years after the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA") reforms and the victory over DDT, the critics are not yet prepared to declare victory. Even worse from the perspective of environmental pressure groups is the change in attitude toward DDT, a substance whose name invokes extraordinary invective,¹⁵ where the current picture is not quite what the advocacy groups predicted. The *New York Times* recently joined public health advocates in favoring the continued use of DDT to combat malaria in developing countries.¹⁶ As a result, environmental pressure groups have been forced to retreat from their goal of a global ban on DDT.¹⁷

Is command and control regulation of pesticides a success story? We contend that it is not. Instead we argue that the regulatory structure created by FIFRA is inferior to the outcomes obtainable under a market approach to pesticides. To make our argument, we first outline current pesticide use and reasons farmers continue to use them in Part I. We then describe the principles that inform a market approach to environmental problems in Part II, followed by a discussion on how decisions about pesticide use are made, something that the current regulatory structure largely ignores. Next, in Part

¹² See, e.g., World Resources Institute Report 1998-1999.

¹³ See, e.g., Ruhl, *supra* note 11, at 282-83 (discussing increase in use and citing primary sources).

¹⁴ See, e.g., Pep Fuller & Thomas O. McGarity, *The Bush Administration's Cautious Approach to Listing New Persistent Organic Pollutants and the Future of the POPs Convention*, 28 WM. & MARY ENVTL. L. & POL'Y REV. 1 (2003); Kristina Thayer & Jane Houlihan, *Pesticides, Human Health and the Food Quality Protection Act*, 28 WM. & MARY ENVTL. L. & POL'Y REV. (forthcoming Winter 2004) (2004); see also JOHN WARGO, *OUR CHILDREN'S TOXIC LEGACY: HOW SCIENCE AND LAW FAIL TO PROTECT US FROM PESTICIDES* (2d ed. 1996). It is not at all clear that the litany of harms is correct. See LOMBORG, *supra* note 1, at 226-48 (discussing evidence on pesticides and concluding that stopping pesticide use would save twenty lives per year at a cost of \$20 billion per year and 26,000 increased deaths from cancers). For a critique of environmental groups' anti-pesticide campaigns, see JONATHAN H. ADLER, *ENVIRONMENTALISM AT THE CROSSROADS: GREEN ACTIVISM IN AMERICA* 38-40 (1995).

¹⁵ See, e.g., Patrick Parenteau, *She Runs with Wolves*, 21 VT. L. REV. 743, 747 (1997) ("DDT was not just a pest killer, it was an eagle killer, an osprey killer, a peregrine falcon killer, an indiscriminate killer.").

¹⁶ *Fighting Malaria with DDT*, N.Y. TIMES, Dec. 23, 2002, at A24.

¹⁷ See Don Mayer, *The Precautionary Principle and International Efforts to Ban DDT*, 9 S.C. ENVTL. L.J. 135, 175-78 (2002) (describing negotiations over DDT provisions in POPs treaty).

III, we briefly outline four examples that illustrate the problems with centralized regulatory solutions and the superiority of decentralized approaches to environmental problems. We conclude in Part IV by offering some policy principles for pesticides.

The reader should note that this Article is not a comprehensive statement of the case against central planning in pesticides, something that space considerations prevent here and which we hope to provide in the future. Rather, because of the power of the pesticide “fables” that currently dominate the current debate,¹⁸ our goal is simply to suggest that there are alternatives to FIFRA and other one-size-fits-all rules, such as the ban on DDT production, that need to be considered.

I. PESTICIDE USE

People use a lot of pesticides each year, and a significant proportion of pesticides applied are used in the United States. In the United States alone, estimates are that more than seven hundred million pounds of pesticides are used by farmers each year, at a cost of over \$4 billion.¹⁹ It appears technically

¹⁸ We echo Jonathan Adler’s application of the word “fable” to environmental history. See Jonathan H. Adler, *Fables of the Cuyahoga: Reconstructing a History of Environmental Protection*, 14 *FORDHAM ENVTL. L.J.* 89, 146 (2003). Adler, writing the first comprehensive account of the famed 1969 fire on the Cuyahoga River, described the fire as a “fable” because the term connotes,

a fictitious narrative that nonetheless conveys an important truth. See, e.g., *MERRIAM-WEBSTER’S COLLEGIATE DICTIONARY* 415 (10th ed. 1998) (defining a fable as “a fictitious narrative or statement: as,” among other things, “a narration intended to enforce a useful truth.”). The fables of the Cuyahoga are narratives of the river’s plight which purportedly explain the evolution of federal water pollution controls.

Id. at 93 n.14. Adler concludes that:

[w]hile it is relatively easy to identify the failings of existing fables, it is difficult to construct an alternative narrative that does not present problems of its own. History, unlike a fable, is nuanced and complex.... There are many threads which may be woven together to generate many different fables. Some will be more consistent with the data than others. None will be a perfect fit.

Id. at 146. Our alternative fables, set forth below, lack the nuance and complexity of the complete story of each of these episodes. Our point is not to write the definitive history of each of these—something the space limitations of a single symposium article would not permit—but to illustrate some of the several important truths that the dominant versions of these fables do not include.

¹⁹ David Pimentel et al., *Environmental and Economic Effects of Reducing Pesticide Use in Agriculture*, 46 *AGRIC., ECOSYSTEM & ENV’T* 273, 273 (1993). But see John R. Finney, *Optimizing the Use of Pesticides*, 42 *PESTICIDE SCI.* 69, 69 (1994) (“there is general

feasible to significantly reduce the amount of pesticides used.²⁰ Why then are so many pesticides used?²¹ We find that this is a puzzle for the command and control proponents in the pesticide literature, because it requires them to reconcile farmers and ranchers' behavior, the deliberate introduction into the environment of pesticides, which is, to them, a bad thing, with their Jeffersonian view of small farmers as morally privileged.²² Central planning advocates often resolve the puzzle by postulating that farmers and ranchers who use pesticides do so because they are tricked by chemical companies, ignorant of the consequences of pesticide use, or, in the case of "corporate" farmers,²³ are deliberately sacrificing the general welfare for corporate profits.²⁴

Pesticides are an input into agriculture and are used because they produce a sufficient increase in crop yield, including crop quality, to at least cover the cost to the decision maker of using them. In short, farmers use pesticides because they make more money when they use them than when

agreement that, in the absence of pesticides, global crop yields would be at least 30% lower overall").

²⁰ Pimentel et al., *supra* note 19, at 273 ("Several studies suggest that it is technologically feasible to reduce pesticide use in the US by 35-50% without reducing crop yields.").

²¹ By far the most important use of pesticides in the United States is in agriculture, using approximately eighty percent of pesticides used in the United States. David Pimentel et. al., *Environmental and Social Costs of Pesticides: A Preliminary Assessment*, in 1 CRC HANDBOOK OF PEST MANAGEMENT IN AGRICULTURE 721 (David Pimentel ed., 2d ed. 1990). There are other important uses, such as pest control in homes, but we will focus on agricultural use since it is the target of much of the criticism.

²² See Peter J. Hill, *What's So Special About the Farm?*, in AGRICULTURAL POLICY AND THE ENVIRONMENT, *supra* note 11, at 1, 12-13 (discussing role of family farm ideology in agricultural policy making).

²³ Environmental pressure groups have trouble with family farmers' use of pesticides in particular, because they glorify small scale agriculture, much as the anti-tobacco movement has trouble with determining how to treat tobacco farmers. For one of the few environmental writers to write critically of small farms, see Deborah L. Donahue, *Justice for the Earth in the Twenty-First Century*, 1 WY. L. REV. 373 (2001). For a more nuanced, but still critical view of farms and the environment, see Ruhl, *supra* note 11, at 10,203 ("The plain truth is that farms pollute groundwater, surface water, air, and soils; they destroy open space and wildlife habitat; they erode soils and contribute to sedimentation of lakes and rivers; they deplete water resources; and they often simply smell bad.").

²⁴ See, e.g., GORE, *supra* note 3, at 184 (recounting "short term" perspective that leads to heavy pesticide use).

People who lease the land for short-term profits often don't consider the future. From fence row to fence row, they strip-mine the topsoil and move on. And even if you own the land, it's hard to compete in the short term against somebody who doesn't care about the long term.

Id. at 3.

they do not.²⁵ Their willingness to spend substantial amounts, such as \$8.5 billion in 1996, is convincing evidence that farmers find pesticide use profitable.²⁶ Any pesticide policy that hopes to have an impact on pesticide use will have to take this fact into consideration rather than relying on assumptions of farmer ignorance or disregard for the environment. Unfortunately, most of modern pesticide policy does not do so.²⁷ We will return to that point shortly, but let us consider the use decision in more detail first.

At the risk of grossly oversimplifying the decision making process, let us consider the alternatives a farmer faces in growing her crops. First, our farmer must decide what to grow, as a great deal of agricultural land will support more than one type of crop. As “[s]election of a particular crop to grow is likely the single most important pest management decision a grower will make,”²⁸ this has a significant impact on pesticide use. For example, crop land in northern Ohio where one of us lives can be used to grow both soybeans and corn (and other things too). Land can also be left fallow, to “rest” it and improve its productivity, because crop prices do not support its use, because weather prevents timely planting, due to payments to take it out of production for conservation purposes, or many other reasons. Second, when should the farmer plant? Delaying planting can reduce the need to use herbicides, for example, but also reduces yields.²⁹ Third, having decided what to grow, our farmer must decide how intensively she will farm her land. Should she plant “hedgerow to hedgerow” or leave buffer strips that protect

²⁵ Pimentel et al., *supra* note 19, at 274 (“Dollar returns for the direct benefits to farmers have been estimated to range from \$3 to \$5 for every \$1 invested in the use of pesticides . . .”). Farmers also use pesticides as a form of insurance, to reduce risk. See J. Palti, *Farmers’ Perceptions of Pest and Disease Control*, in ADVISORY WORK IN CROP PEST AND DISEASE MANAGEMENT 20 (J. Palti & R. Ausher eds., 1986); Craig D. Osteen, *The Policy and Economic Issues of Pest Control and Energy Use*, in ENERGY IN PLANT NUTRITION AND PEST CONTROL 271-72 (Zane R. Helsel ed., 1987) (discussing impact of risk aversion on pesticide use).

²⁶ JORGE FERNANDEZ-CORNEJO & SHARON JANS, DEP’T OF AGRIC., PEST MANAGEMENT IN U.S. AGRICULTURE 1 (Agric. Handbook No. 717, 1999).

²⁷ See Donald T. Hornstein, *Lessons from Federal Pesticide Regulation on the Paradigms and Politics of Environmental Law Reform*, 10 YALE J. ON REG. 369, 392 (1993) (“it is important to underscore what pesticide regulation is not: it is not a body of law that addresses in any strategic way the underlying prevalence of pesticides in American agriculture, nor is it a body of law designed to minimize pesticide use”). We disagree with much of Prof. Hornstein’s analysis, but agree with his assessment of the lack of a systematic approach in pesticide law.

²⁸ M. Barrett & W.W. Witt, *Alternative Pest Management Practices*, in ENERGY IN PLANT NUTRITION AND PEST CONTROL, *supra* note 25, at 197, 197.

²⁹ *Id.* at 204.

streams and neighboring land from "drift" of any chemicals she might apply to the land? Should she use fertilizers to increase productivity? Should she spray herbicides to control weeds, use bioengineered crop strains to allow enhanced herbicide use, substitute labor for chemicals and have weeds removed by hand, change tilling practices to affect weed growth, or some combination of the above? Should she spray for insects whenever she sees a destructive species in the field or use a sophisticated computer model to predict when the economic threshold has been reached that justifies spraying?³⁰ If she sprays, should the pesticide be applied by hand? By plane? By tractor? What should she spray? Or should she drop chemical use altogether and become an organic farmer? Even if we pretend that these decisions need be made only once per season, when many of them must be made almost daily, it is easy to see that pesticide use is merely a small part of a complex set of business decisions that farmers must make.

Pesticides are an expensive input³¹ and farming is a low margin business.³² It seems unlikely, therefore, that farmers would routinely make uninformed and incorrect decisions about pesticide use that cost them money. Certainly farmers that did routinely make bad decisions about pesticides would be throwing away money, either by needlessly applying an expensive input to their land or by allowing weeds or insects to unnecessarily and unprofitably reduce their crop yields. Those farmers would be at a competitive disadvantage compared to farmers who made smarter decisions about pesticides and, in time, would be driven out of business. The market should work and optimal pesticide decisions should result.

This picture is not quite right, however. There are three major problems with the simple market story. First, the economic calculations of farmers are subject to massive distortion from government agricultural programs. Second, pesticides have impacts beyond the fields in which they are applied, what economists usually call "externalities." These impacts may mean that farmers' decisions, based on the costs and benefits of pesticides to farmers and optimal from each individual farmer's perspective, are not socially opti-

³⁰ See C.H. Blazquez et al., *Remote Sensing by Aerial Infrared Colour Photography as an Aid in Monitoring Crops for Pests and Diseases*, in *ADVISORY WORK IN CROP PEST AND DISEASE MANAGEMENT*, *supra* note 25, at 103, 103-06 (describing several such systems).

³¹ See, e.g., H. Frankel, *Pesticide Application: Technique and Efficiency*, in *ADVISORY WORK IN CROP PEST AND DISEASE MANAGEMENT*, *supra* note 25, at 132, 156 ("Pesticides must be used at their lowest effective doses, because they are expensive . . .").

³² See generally, Ruhl, *supra* note 11 (discussing farm economics in the context of environmental issues).

mal as social costs and benefits may diverge from private costs and benefits.³³ Third, pesticides serve an important function for farmers beyond killing pests; using pesticides serves as a form of insurance for farmers.³⁴

Nonetheless, there is a powerful incentive not to throw money away on inputs that do not add value. The technological feasibility of reducing pesticide use is not the only issue; the economic feasibility is also important. For example, even Dr. Pimentel and his colleagues, who argue pesticide use could be substantially cut, concede that doing so would require additional expenditures of \$1 billion.³⁵ In particular, pesticides are a substitute for labor in many instances.³⁶ Spraying an herbicide on a cotton field is a substitute for using manual labor to remove weeds.³⁷ There are social and environmental impacts of the substitution in addition to the possible social costs of using the herbicide that need consideration in any attempt at a cost-benefit analysis. Farm labor, for example, is dangerous, unpleasant work often performed by children.³⁸ Limiting the availability of herbicides for cotton will most likely lead to increased child labor, increased injuries to children working in the fields,³⁹ and decreased availability of education for farm worker children⁴⁰ as farmers substitute labor for chemical weed control. Hand weeding also has

³³ See, e.g., Pimentel et al., *supra* note 19, at 274 (noting indirect costs).

³⁴ See J.D. Mumford, *A Study of Sugar Beet Growers' Pest Control Decisions*, 97 ANNALS APPLIED BIOLOGY 243, 248 (1981) ("Insurance was the principle reason for using insecticides for 44 of the farmers interviewed [of 60]."); see also Hornstein, *supra* note 27, at 397-98 (describing insurance theory of pesticide use).

³⁵ Pimentel et al., *supra* note 19, at 283.

³⁶ Maurice B. Green, *Energy in Pesticide Manufacture, Distribution and Use*, in ENERGY IN PLANT NUTRITION AND PEST CONTROL, *supra* note 25, at 165, 176-77 (noting that pesticides substitute capital and energy for labor); Osteen, *supra* note 25, at 267 ("Pesticides have displaced more labor-intensive methods of pest control such as cultivation."); K.M. Jones et al., *Spray Application Technology*, 31 PLANT GROWTH REG. 173, 174 (2000) (noting that labor costs led to adoption of hydraulic, air-blast equipment in place of hand lances because the former were "faster and less labour intensive"); see also, Pimentel et al., *supra* note 19, at 281 ("It would be possible to reduce herbicide use on corn by up to 60% if the use of mechanical cultivation and rotations were increased.").

³⁷ G.A. MATTHEWS, PESTICIDE APPLICATION METHODS 4 (3d ed. 2000) ("Herbicide use has increased most where labour costs are high, there is a peak labour demand, or where mechanical hoeing will cause damage to the young crop.").

³⁸ See HUMAN RIGHTS WATCH, FINGERS TO THE BONE: UNITED STATES FAILURE TO PROTECT CHILD FARMWORKERS (2000), available at <http://www.hrw.org/reports/2000/firmwrkr/>.

³⁹ Frank B. Cross, *Paradoxical Perils of the Precautionary Principle*, 53 WASH. & LEE L. REV. 851, 871-72 (1996).

⁴⁰ See Teresa Young Reeves, *Harvest of Danger: The Child Farmworker in the United States*, 8 HUMAN RIGHTS BRIEF 12, 14 (2001) ("According to a 1991 study by the U.S. Department of Education, the impact of the farmworker lifestyle on education showed 80 percent of adult migrant farmworkers function at a fifth grade literacy level or less.").

environmental costs as it causes “general disturbance of [the] soil” that “can increase erosion of some soils.”⁴¹ Deciding whether the social costs outweigh the social benefits of pesticide use is thus not an easy task—and much more difficult than much of the central planning pesticide literature suggests.

Modern pesticide policy is built around fixing the so-called externality problems through a centralized, command and control regulatory regime.⁴² Pesticides may only be used if EPA, the central regulator, determines that they may.⁴³ In evaluating pesticides, EPA considers the crop losses that will result if a particular pesticide is not available, the environmental impact of the pesticide’s use, and the human health effects.⁴⁴ It then grants permission for specific uses,⁴⁵ requires specific language explaining the proper methods of use on the pesticide’s label,⁴⁶ and prohibits the use of the pesticide for anything other than the approved uses.⁴⁷ At least in theory, EPA balances the benefits and costs, allowing only pesticides that produce a net benefit.⁴⁸ Reasonable people, and unreasonable people too, might disagree over particular cost-benefit calculations or interpretations of toxicity data, but the data should confine those disagreements to a relatively narrow band.⁴⁹ They often do not because of the deep value differences between agricultural interests and environmental pressure groups over issues such as how to factor in uncertainty.⁵⁰

Unfortunately, this approach neglects the economic calculations made by farmers about pesticide use. Simply announcing a rule and the penalties for disobeying it are insufficient to change behavior in many instances.⁵¹

⁴¹ MATTHEWS, *supra* note 37, at 4.

⁴² See David Haddock, *When Are Environmental Amenities Policy Relevant?* (2003) (Working Paper, Northwestern University School of Law, on file with authors).

⁴³ See 7 U.S.C. § 136(a) (2000) (“registration pesticides”); 7 U.S.C. § 136(p) (2000) (including emergency registration provisions); 7 U.S.C. § 136(v) (2000) (including special local needs registrations).

⁴⁴ See Osteen, *supra* note 25, at 277-79 (discussing alternative pesticide availability as a factor in EPA’s decision making).

⁴⁵ See 7 U.S.C. § 136(a) (2000).

⁴⁶ RODGERS, *supra* note 9, at 470-79 (discussing labeling requirements).

⁴⁷ There are a host of other regulations as well, requiring those using particular pesticides to be licensed to do so, allowing minor variations on uses to deal with emergencies or special local needs but the basic structure of the program is as described.

⁴⁸ RODGERS, *supra* note 9, at 449-55 (discussing registration process).

⁴⁹ We recognize that some farmers make rational economic calculations to avoid pesticide use. See J. BISHOP GREWELL & CLAY J. LANDRY, *ECOLOGICAL AGRARIAN: AGRICULTURE'S FIRST EVOLUTION IN 10,000 YEARS* 17-18 (2003).

⁵⁰ See generally BOSSO, *supra* note 9.

⁵¹ Anyone who doubts this should simply reflect on the continued existence of various crimes

Rather, pesticide policy needs to recognize that farmers use pesticides primarily because they make more money when they do so than when they do not.⁵² Farmers may be mistaken about particular facts that influence their decisions, but they are unlikely to be either systematically fooled by chemical companies or so ignorant as to make systematic errors in favor of excessive pesticide use.⁵³

Where there are information problems that lead to over-use, correcting the underlying information problem is almost always more effective and less expensive than other means of solving the problem⁵⁴—if only because identifying the problem presumes that the regulator has already obtained the information the farmer needs. Even the much lamented shift to “corporate” farming⁵⁵ cuts in favor of such solutions over command and control solutions.

despite laws forbidding them, including crimes dangerous to the participants. See Randy Barnett, *Bad Trip: Drug Prohibition and the Weakness of Public Policy*, 103 YALE L.J. 2593 (1994) (reviewing STEVEN B. DUKE & ALBERT C. GROSS, AMERICA’S LONGEST WAR: RETHINKING OUR TRAGIC CRUSADE AGAINST DRUGS (1993)).

⁵² See, e.g., Barrett & Witt, *supra* note 28, at 226 (“To the farmer, the most important analysis is the return on the investment in weed control costs.”).

⁵³ We do not contend that farmers never make mistakes. There is ample evidence that they do. See, e.g., M. Barrett & W.W. Witt, *Maximizing Pesticide Use Efficiency*, in ENERGY IN PLANT NUTRITION AND PEST CONTROL, *supra* note 25, at 235, 245 (noting that calibrations are frequently incorrect on farmers’ equipment). What we are arguing is that such errors are rarely systematically in the direction of unnecessary use of an expensive product. Thus, for example, the calibration errors noted above have thirty-two percent of farmers applying ten percent or more below the intended rate and thirty percent of farmers applying ten percent or more above the intended rate, a rough equivalence. *Id.* Moreover, the fact that more precise calibration is possible does not mean it is economically feasible. Calibrating equipment has a cost and will only be done to the extent it repays the cost of doing so. Farmers who overspray and could have a net increase in profits if they calibrated their equipment more precisely will suffer economically compared to those who do calibrate their equipment more precisely. See, e.g., B.S. Butler & L.E. Dode, *Effects of Application Methods in Energy Use*, in ENERGY IN PLANT NUTRITION AND PEST CONTROL, *supra* note 25, at 235, 263-65. Farmers who overspend on calibration, however, will also suffer economically compared to those who do not. *Id.*

Prof. Hornstein hypothesizes that farmers may use excessive pesticides due to the existences of prisoner’s dilemmas, tragedies of the commons, or externalities. See Hornstein, *supra* note 27, at 396. In the absence of data demonstrating that these effects are present, we argue that they are an inadequate basis for policy.

⁵⁴ See, e.g., Mumford, *supra* note 34, at 250 (noting English sugarbeet growers accurately assess risk of loss from a virus but overestimate efficacy of pesticide treatments).

⁵⁵ See, e.g., Donahue, *supra* note 23, at 376 (“Our devotion to the family farm and ranch, which dates to Thomas Jefferson’s time, continues to provide the gloss on, if not the impetus for, most of our national and state agricultural policies.”). *But see* Hosemann, *supra* note 11, at 173-74, 185 (arguing increasing scale of farming improves environmental quality while giving an example of lessened impact of planting and harvesting due to increased scale of operations).

Corporations, as their critics constantly point out,⁵⁶ are about making money and throwing away money on unnecessary inputs is not something that markets reward.⁵⁷

Modern pesticide policy says almost nothing about the first problem, however. Almost every aspect of a farmer's decision making is distorted by government-led agricultural programs.⁵⁸ Which crop to plant, how intensively to farm, whether to let fields lie fallow in some years, and whether to maximize output are all questions that a rational farmer cannot make without considering agricultural programs.

The net effect of these programs is an increase in pesticide use. For example, the cotton price support program increases pesticide use by ten percent according to one estimate.⁵⁹ Soybeans are heavily subsidized,⁶⁰ leading more farmers to plant them than would otherwise⁶¹ and are also a crop with extensive pesticide use.⁶² Corn production is increased by the sugar program, which raises the price of sweeteners, thereby raising corn production to produce more corn sweeteners.⁶³ The ethanol program also increases

⁵⁶ See, e.g., Beth Stephens, *The Amoralty of Profit: Transnational Corporations and Human Rights*, 20 BERKELEY J. INT'L L. 45, 46 (2002).

⁵⁷ The "six sigma" approach to quality control is a good example of the rewards of close attention to costs through reducing defects. See, e.g., George Eckes, *Making Six Sigma Last (and Work)*, IVEY BUS. J., Jan.-Feb. 2002, at 77, 77 (describing how six sigma quality control process "has helped save billions of dollars while improving customer satisfaction ratings and stock prices as well"). For a general description of how companies focus on quality control to save money, see Michael Arndt, *Quality Isn't Just for Widgets*, BUS. WK., Jul. 22, 2002, at 72.

⁵⁸ See BOSSO, *supra* note 9, at 63-64 ("Federal agricultural policy, whether Democratic or Republican in origin, in many ways unwittingly promoted heavier pesticides use.").

⁵⁹ Pimentel et al., *supra* note 19, at 280.

⁶⁰ The 2002 farm bill, for example, offered a support price of \$5.00/bushel for soybeans, whose market price had been \$4.10-4.40/bushel the year before. By comparison, the support price for corn was only \$1.98/bushel compared to market prices the preceding year of \$1.85-1.95. The support price for wheat was set at \$2.80/bushel compared to prior year market prices of \$2.75-2.85/bushel. See David Rogers, *House Passes Massive Farm Bill*, WALL ST. J., May 3, 2002, at A12. Soybeans' subsidy of thirteen to twenty-two percent over market, compared to corn's subsidy of two to three percent above market and wheat's subsidy of 1.7% to -1.5%. See *id.*

⁶¹ See, e.g., Peter Harriman, *Conversions to Farmland Threaten S.D. Environment*, ARGUS LEADER, Apr. 8, 2003, at A4 (describing how federal agricultural programs for soybeans are harming wildlife habitat in South Dakota), available at 2003 WL 6770627.

⁶² Pimentel et al., *supra* note 19, at 281.

⁶³ See Ctr. for Responsive Politics, *The Politics of Sugar: The 1990 Farm Bill*, at http://www.opensecrets.org/pubs/cashingin_sugar/sugar05.html (last visited Aug. 31, 2003) (noting that corn producers receive \$548 million per year in benefits from the sugar subsidy program's increase in sugar prices' influence on corn sweetener sales).

corn production.⁶⁴ As corn is one of the most chemical intensive crops, these subsidies also boost pesticide use.⁶⁵ Indeed, the four crops accounting for the vast majority of American pesticide use—corn, cotton, soybeans, and wheat⁶⁶—are all heavily subsidized. The structure of many farm programs also encourages intensive use of limited land rather than less-intensive use of more land,⁶⁷ thus promoting use of inputs that raise yield, such as pesticides and fertilizers, and discouraging practices that minimize the impacts of those inputs, such as leaving buffer strips⁶⁸ between fields and streams. “Each farmer’s rational response [to acreage based programs] could be but one thing—take the cash, and then maximize profits by producing as much as possible on the unrestricted acreage.”⁶⁹

Failing to recognize the importance of agricultural programs on farmers’ decisions to use and not use pesticides dooms those programs to failure. A centralized regulatory scheme can work only when regulators have access to and consider the relevant information set.⁷⁰ Can it succeed at more limited objectives? Pesticide registration can certainly keep some harmful products from the market if it is built around appropriate data requirements and has sufficient technical resources to evaluate the data it requires.

⁶⁴ The ethanol program uses approximately seven percent of the United States’ corn crop. Gary D. Liebcap, *Agricultural Programs with Dubious Environmental Benefits: The Political Economy of Ethanol*, in AGRICULTURAL POLICY AND THE ENVIRONMENT, *supra* note 11, at 89, 90. For critiques of the environmental consequences of the ethanol program and discussion of the special interest politics underlying it, see *id.* (describing ethanol program and its environmental impacts); Jonathan H. Adler, *Clean Politics, Dirty Profits: Rent Seeking Behind the Green Curtain*, in POLITICAL ENVIRONMENTALISM: GOING BEHIND THE GREEN CURTAIN 1, 9-13 (Terry L. Anderson ed., 2000).

⁶⁵ Zane R. Helsel, *Pesticide Use in World Agriculture*, in ENERGY IN PLANT NUTRITION AND PEST CONTROL, *supra* note 25, at 179, 189 (writing that corn is one of the top two crops for herbicides and is the top crop for insecticides).

⁶⁶ FERNANDEZ-CARNEJO & JANS, *supra* note 26, at 3 (“In 1995, four crops—corn, soybeans, cotton, and wheat—accounted for more than 85 percent of the herbicides used, and two crops (corn and cotton) accounted for nearly 65% of the insecticides used.”).

⁶⁷ BOSSO, *supra* note 9, at 29 (noting that “[c]ontrols were placed on acreage, not production” meant farmers increased intensity of farming on acres planted. (quoting HARRISON WELLFORD, *SOWING THE WIND* 253 (1972))); Hosemann, *supra* note 11, at 173 (“On balance, government-sponsored research, direct government subsidy payments to farmers, and commodity price guarantees have resulted in high-tech, high-yield intensive agriculture.”).

⁶⁸ Graham A. Matthews & Neale Thomas, *Working Towards More Efficient Application of Pesticides*, 56 PEST MGMT. SCI. 974, 975 (2000) (“The aim of these buffer zones is to protect sensitive ecological areas, especially water surfaces downwind of fields sprayed with pesticide.”).

⁶⁹ BOSSO, *supra* note 9, at 29.

⁷⁰ WILLS, *supra* note 11, at 103-20 (describing limits of central planning approach to environmental problems).

The question is not whether it is theoretically possible to identify harmful chemicals in advance, however, but whether the net impact of screening new products will be positive. Registration is expensive—a single new product is estimated to cost \$40 to \$80 million to develop.⁷¹ As a result, companies introduce fewer new products than would be introduced in the absence of registration. If most of the products avoided are worse than existing products, this would not be a problem. If, on the other hand, newer pesticides are better for the environment than older ones, slowing innovation could be harmful as it delays the introduction of environmentally safer products. There is some evidence that newer products are generally preferable on environmental grounds to older products,⁷² suggesting that the slowing of innovation caused by the expense of registration is harmful to the environment.

To briefly summarize, pesticide use is a complex decision made by individuals in response to a variety of factors.⁷³ Among the most important of these factors is the impact of agricultural programs that change farmers' decisions about how to conduct their businesses. To successfully influence pesticide use, regulatory programs must take into account these factors, and the current command and control structure does not do so effectively, and cannot be expected to because of the special interests that dominate agricultural and environmental policy.

II. FREE MARKET ENVIRONMENTALISM

An alternative to central planning is reliance on decentralized institutions, including the common law and markets. The market approach to environmental issues is based on a few simple principles. These include:

⁷¹ Roger Anthony Downer, *The Impact of Spray Modifiers on Pesticide Dose Transfer 2* (1998) (unpublished Ph.D. dissertation, University of Portsmouth); Green, *supra* note 36, at 176 (\$74 million estimate).

⁷² See *infra* note 114.

⁷³ Frankel, *supra* note 31, at 132.

Optimal application methods can be defined only when account is taken of all factors influencing the dispersal of the pesticide over its target surface, and its deposition and adherence to that surface. Also to be taken into consideration are the characteristics of the pest, its mobility and site on the host, as well as environmental conditions, such as temperature, relative humidity and air movement.

Id.; see also Mumford, *supra* note 34, at 243 (“A farmer’s pest control decision is determined by his goals (which influence the decision rules by which he chooses control actions), the range of protection measures of which he is aware and able to employ, and his perceptions of the hazard posed by pests and the effectiveness of controls . . .”).

- Market incentives spur individuals to conserve resources and protect environmental quality;
- Private property rights encourage stewardship of resources;
- Polluters should be liable for the harm they cause others; and
- Government subsidies often degrade the environment.

Let us consider briefly why each of these principles is important for improving environmental quality.

Free market environmentalism falls on the Coasian side of the Coase-Pigou divide.⁷⁴ Coasian analysis emphasizes “contract and property-rights enforcement and relies on market successes” while Pigovian analysis focuses on market failures and government action to correct those failures.⁷⁵ The great advantage of the Coasian approach is that it need not solve the central planner’s problem of simultaneously preventing regulatory capture and gathering sufficient information to be able to select the appropriate policy. By emphasizing decentralized markets and neutral legal principles, Coasian solutions sidestep these hard problems; problems that, as our next section illustrates, are important obstacles to coherent pesticide policy. Pigovian analysis, on the other hand, requires a great deal of knowledge to calculate optional subsidies and taxes to induce people to conform to the calculated social optimum behaviors.

A. *Market Incentives*

It is a common practice in environmental literature to blame markets for environmental problems. For example, market critics often note that polluters use the atmosphere or rivers as “free” disposal services, causing pollution. Although such things occur, it is also important, but less common, to consider whether markets play a role in protecting the environment as well.

Markets can help the environment in two crucial respects. First, when resources are allocated by markets, resource owners are subject to the discipline of the marketplace

because the wealth of the property owner is at stake if bad decisions are made. Moreover, if private owners can sell their

⁷⁴ See Bruce Yandle, *Public Choice and the Environment: From the Frying Pan to the Fire*, in POLITICAL ENVIRONMENTALISM: GOING BEHIND THE GREEN CURTAIN, *supra* note 64, at 31, 34-35.

⁷⁵ See *id.* at 33-39 (elaborating on distinction between two approaches).

rights to use resources, the owners must not only consider their own values, they must also consider what others are willing to pay. In the market setting, it is the potential for gains from trade that encourages cooperation.⁷⁶

Markets thus allow resource use to change based on changing conceptions of value, force resource owners to consider the long-term value of their assets and the impact of their actions upon that value, and offer individuals who disagree with others' resource allocation decisions the opportunity to bid the resources away from those with whom they disagree about appropriate use.⁷⁷

Second, when markets are involved, transactions benefit from the market's power to convey information in a concise, low-cost format.⁷⁸ Markets solve what Nobel Laureate Friedrich Hayek called the "information problem."⁷⁹ Making decisions about resources requires knowing a great deal of information about alternative uses of those resources. For example, if someone is trying to decide whether or not to buy a particular car, the buyer must know what her alternatives are for transportation. Could she ride public transit to her destinations instead? Which model car offers the best combination of features (mileage, leg room, safety, amenities such as CD players and leather seats) for her needs? Markets assist in making such evaluations by reducing much of the information to easy-to-understand prices. The prospective car buyer does not need to know about the alternative uses of the resources that go into making a car stereo, she only needs to know the price of that option to make a decision about whether her desire for a car stereo can be met. A central planner, on the other hand, would have great difficulty

⁷⁶ TERRY L. ANDERSON & DONALD R. LEAL, *FREE MARKET ENVIRONMENTALISM* 4 (rev. ed. 2001).

⁷⁷ Hill, *supra* note 22, at 1 ("In a market economy, competing claims are resolved through bids and offers between owners and potential owners. Individuals who believe they have a better use for a resource can gain control of that resource by offering to pay more than its opportunity cost.")

⁷⁸ Friedrich A. Hayek, *The Use of Knowledge in Society*, 35 *AM. ECON. REV.* 519 (1945).

⁷⁹ *Id.* at 519-20.

The peculiar character of the problem of a rational economic order is determined precisely by the fact that the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess. The economic problem of a society is . . . a problem of the utilization of knowledge [which is] not given to anyone in its totality.

assembling information on all car buyers' level of interest in car stereos, the alternative uses of those resources, the cost of production, and other factors. Thus, markets offer a key advantage—they efficiently process information and allow decentralized decision making.

The final advantage of markets is that when information changes, through new discoveries or through changes in values, markets can quickly convey those changes through price changes. Those price and value changes in turn offer entrepreneurial opportunities to make a profit by exploiting the changes. Thus, for example, if a particular product is discovered to be environmentally harmful and at least some people value the environment, an entrepreneur can make a profit by offering an alternative that is less harmful than the old product.⁸⁰

B. *Private Property*

Markets do not always work, however. Polluters do treat the air and water as a disposal resource when they can do so at a lower cost than paying to dispose of wastes. The problem is not, however, that polluters are misusing their property, but that they are misusing resources owned by others. This is a particular problem when the resource is “unowned” or held in some form of common property without well-defined use rights amongst the owners.⁸¹ For example, if no one “owns” a stream’s water quality, a factory owner will take that attribute of the stream by using it as a waste disposal source. It is the

⁸⁰ For a general discussion of the role of entrepreneurs in solving environmental problems, see TERRY L. ANDERSON & DONALD R. LEAL, *ENVIRO-CAPITALISTS: DOING GOOD WHILE DOING WELL* (1997) [hereinafter ANDERSON & LEAL, *ENVIRO-CAPITALISTS*]. Anderson and Leal define “enviro-capitalists” as

entrepreneurs using business tools to preserve open space, develop wildlife habitat, save endangered species, and generally improve environmental quality. These entrepreneurs are meeting the growing demand for recreational and environmental amenities. To do this, enviro-capitalists must invent new products, attract venture capital, contract with resource owners, and market their products.

Id. at 3.

⁸¹ See generally Bruce Yandle & Andrew P. Morriss, *The Technologies of Property Rights: Choice Among Alternative Solutions to Tragedies of the Commons*, 28 *ÉCOLOGY L.Q.* 123 (2001) (examining different alternative solutions to tragedies of the commons and technology specific problems).

lack of property rights, however, not their existence, that is responsible for the problem. Where water quality rights are private property, the owners can take actions to protect their property rights and water quality is protected.⁸²

Unfortunately, in agriculture "property rights have been dramatically attenuated"⁸³

Such attenuation of rights has made it possible for politicians, farmers, and environmentalists to ignore the full opportunity costs of their actions. Instead of bidding for control of resources through the marketplace, interested individuals and groups must bid in the political arena. But resource control in that arena is tenuous at best. Resource rents, including the flow of income from commodity production and the amenity rents desired by environmentalists, are continually up for grabs. Under such a system competing claimants face an incentive structure that encourages them to attempt to have property rights redefined in their favor. And the threat of redefinition that takes rights away from an existing holder means politicians can engage in an ongoing process of selling protection.⁸⁴

More generally, public "ownership" of resources such as the atmosphere and the oceans can be considered an example of the tragedy of the commons. All such tragedies

raise two questions: who has what rights and what are the costs associated with defining and enforcing those rights? Where rights are clearly defined and easily enforced, as in the case of surface land, there is no tragedy, because entry is limited by the owner's fence. If party A dumps his garbage on party B's land, party B can enforce his right against trespass. On the other hand, where rights are not well defined or easily

⁸² See Roger Bate, *Protecting English and Welsh Rivers: The Role of the Anglers' Conservation Association*, in *THE COMMON LAW AND THE ENVIRONMENT* 86 (Roger E. Meiners & Andrew P. Morriss eds., 2000).

⁸³ Hill, *supra* note 22, at 1.

⁸⁴ *Id.* at 13.

enforced, as with the right to clean air, trespass is much more difficult to prevent.⁸⁵

The key to solving these problems is thus finding the least cost method of ensuring that private property rights can be specified and are cheaply enforceable. Well-specified and defensible private property rights are critical to the functioning of markets. As creating and enforcing private property rights in environmental goods enhances the ability of markets to protect the environment, an important part of the market approach is facilitating the creation and enforcement of private property rights.

C. *Paying for Damages*

Defending property rights requires that those who harm the property of another pay damages for doing so. Courts can also enjoin future harmful activity. Ordinary principles of tort, contract, and property law provide a means for holding rights violators liable.⁸⁶ Payment for harm caused is critical because it provides an incentive for considering the impact of one's conduct on others.

There are limits, however. Damages are owed for harms to actual rights, not for emotional distress over injuries to the property of another. Harms must also be proven, not merely speculative. These limits can cause problems on the frontiers of science because causation is difficult to prove in some cases. (Such problems also afflict central planning solutions, however, since regulators must resolve at least some of the same causation problems to know how to regulate.) Some impacts, such as chemical residues in Antarctic wildlife, may be difficult to remedy directly through tort actions: the wildlife is unowned, the link to any particular person's conduct is difficult to prove, and the harm to the wildlife, as opposed to the mere presence of the residues, may be hard to prove.

The existence of uncompensated harms due to such complications is not determinative of whether market solutions can function, however. The question must always be a comparative institutional one, as the same factors that cause problems for tort solutions may also cause problems for planned

⁸⁵ ANDERSON & LEAL, *supra* note 76, at 13.

⁸⁶ See Roger Meiners & Bruce Yandle, *Common Law and the Conceit of Modern Environmental Policy*, 7 GEO. MASON L. REV. 923, 926-46 (1999) (discussing the common law approach).

solutions. Further, while some harms from a particular action may not be compensable under current tort law, those harms may be linked to other compensable harms. Thus, for example, if drift of a pesticide from one field to another increases harm to birds who inhabit the boundary areas between fields, the harm to the birds may be prevented by the requirement that the pesticide user compensate the neighboring field owner for the harm to his crops caused by the drift.⁸⁷ It may not, however, and it is important to acknowledge that not all harms can be compensated, because causation problems will exist. Uncompensated harms are themselves entrepreneurial opportunities for plaintiffs' lawyers, and, over time, entrepreneurs will reduce the set of uncompensated damages.

D. *Subsidies*

Government action has important implications for individual actions because many government programs create incentives, intentionally or unintentionally, for environmentally destructive behavior.⁸⁸ Generally, government subsidies have been widely recognized as major obstacles to environmental quality.⁸⁹ Such programs succeed in the political arena because they provide concentrated benefits while diffusing their costs over a wide population.⁹⁰

Subsidies and regulations allow "people to ignore the opportunity cost of their actions,"⁹¹ often leading to environmental degradation. Early predator control programs, for example, created incentives to kill wolves through the payment of bounties, justifying this as creation of a public good (removal of predators).⁹² In fact, these programs proved destructive to the environment by disrupting the ecosystem in the Mountain West, leading to massive increases in herds of animals that the predators previously controlled.⁹³ The increased

⁸⁷ See *infra* Part III.D.

⁸⁸ See generally GOVERNMENT VS. ENVIRONMENT (Donald R. Leal and Roger E. Meiners eds., 2002).

⁸⁹ See generally Matthew Brown, *Banking on Disaster: The World Bank and Environmental Destruction*, in GOVERNMENT VS. ENVIRONMENT, *supra* note 88, at 145 (describing impact of World Bank subsidies on environmental projects).

⁹⁰ Hill, *supra* note 22, at 6.

⁹¹ *Id.* at 2.

⁹² See HANK FISCHER, WOLF WARS 10-23 (1995) (describing eradication programs).

⁹³ *Id.* at 26-28 (describing environmental impact of increased prey herds).

herds overgrazed important environmental resources, such as Yellowstone National Park, causing serious environmental damage.⁹⁴

The problem with subsidies is that political decision making often fails to take environmental values into account. As there is no mechanism to force political decision makers to consider the costs of their actions, they often opt for subsidizing activities without doing so. Thus, for example,

Government dams have contributed to the demise of salmon and the loss of wild rivers, and logging on national forests has reduced water quality because not all of the costs are borne by the decision makers. The nature of government funding generates another type of third-party effect by concentrating the benefits on special interest groups while diffusing the costs over a large segment of the population.⁹⁵

The dams subsidize flood control for people down river, electricity for favored customers, and recreation for those who prefer lakes to wild rivers. Logging on federal land at below market prices subsidizes employment in some communities and domestic wood products industries over foreign industries at the expense of consumers. Thus, eliminating subsidies will improve environmental quality by allowing environmentally correct decisions instead of pushing well-financed, politically-favored decisions.

E. *Summary*

To summarize, markets can protect the environment when property rights are well-defined and defensible. The incentive to do so is independent of the preferences of individual resource owners because market prices reflect the values of all those willing to pay for any use of the resource. Those who value environmental attributes of resources thus have the opportunity to outbid those who do not. Environmental values will not always prevail in such bidding contests, but they will influence decision making through their expression in the marketplace.

Resource owners whose property is damaged by the actions of others have the incentive to seek damages from those who harm their property.

⁹⁴ *Id.*

⁹⁵ ANDERSON & LEAL, *supra* note 76, at 20.

Injunctive relief is also an important aspect of protecting property rights. Damages awards and injunctions prevent people from taking actions that harm the property of others.

Distortions that often harm the environment occur when resources are controlled through the political process or where the government subsidizes destructive activity. Political decision making does not have to take into account the preferences of alternative users since it allocates resources based on non-market factors. If investing resources in the political process can yield private benefits, individuals will compete for control of politically determined resources. Lowering the price of environmentally destructive activity through subsidies will result in more of such activity than would exist in a free market. Eliminating the subsidies can thus enhance environmental quality.

III. FOUR ALTERNATIVE PESTICIDES FABLES

Having set out the argument that pesticide use is an economic decision and outlined the market approach to environmental problems, we now turn to our four examples of pesticide policies and the lessons that can be drawn from each for pesticide policy.

We offer these alternative fables not because they "prove" our approach is better than FIFRA's central planning approach, but because they illustrate the issues differently than the dominant DDT fable. The existing approach to pesticides is so ingrained in the literature that we must begin with first principles to describe an alternative. Doing so requires us to illustrate that the issues we contend are important are real. The next step in the debate is to examine data more systematically to determine how best to approach pesticide problems. At this stage, however, we must first establish that there are issues other than the alleged routine poisoning of children, farmworkers, and birds.

A. *Early Pesticides & Legislation*

Pesticide use is a relatively recent innovation. Before the development of the modern organic pesticides in the 1940s,⁹⁶ pesticide use was relatively

⁹⁶ See Green, *supra* note 36, at 165 ("Pesticides in the modern sense date from the discovery during World War II of the phenoxyacetic herbicides and the organochlorine and organophosphorus insecticides.").

limited.⁹⁷ There are two reasons for this. First, prior to the modern era, pest problems were less severe. Second, some early pesticides were less effective and others more acutely toxic than modern pesticides.

Pest problems were less severe in the past because specialized agriculture is rather new in human history. For thousands of years, our ancestors eked out a miserable livelihood scratching the dirt and hunting animals (and each other) to generate the food they needed to survive.⁹⁸ There was little trade or specialization. Since there was limited trade, early agricultural practices generally relied on relatively mixed crop patterns as each area had to produce much of its own food.⁹⁹ As a result, before specialized agriculture appeared, pest problems were, aside from things like plagues of locusts of Biblical proportions,¹⁰⁰ reasonably local problems.¹⁰¹

If, however, instead of having a few apple trees out back along with a mixture of other crops, a farmer now owns an orchard with hundreds of trees and her next door neighbors do as well, because they live in country best suited for apple production, the community now has a quite different set of pest problems than their ancestors experienced due to lack of diversity in the crops they rely on for their livelihood.

The growth of large scale, mono-crop agriculture,¹⁰² something accelerated by the vast network of farm subsidy and other regulatory programs, made pest problems more severe.¹⁰³ Solving them revolutionized American agriculture.¹⁰⁴ In an area covered in apple trees, pests in one farmer's trees

⁹⁷ BOSSO, *supra* note 9, at 29 (describing disadvantages of early pesticides).

⁹⁸ See JARED DIAMOND, GUNS, GERMS, AND STEEL: THE FATE OF HUMAN SOCIETIES 86 (1998).

⁹⁹ BOSSO, *supra* note 9, at 28 (describing pest control advantages of crop rotation).

¹⁰⁰ See *Exodus* 10:13-14, 19.

¹⁰¹ Y. Elkana et al., *Crop Protection Advice: Its Place in the General Scheme of Farming and of Farm Advice*, in ADVISORY WORK IN CROP PEST AND DISEASE MANAGEMENT, *supra* note 25, at 7, 8 ("Crop protection is not an important factor in low-level, subsistence farming where production proceeds in a more or less stable agro-ecosystem, and epidemic disease or pest outbreaks are rare.").

¹⁰² See BOSSO, *supra* note 9, at 23-24, 28-29 (describing the "revolution" in agriculture that followed World War II and the impact on farm techniques that followed).

¹⁰³ See MATTHEWS, *supra* note 37, at 3 ("Modern farming practices have more intensive production of relatively few crops over large areas . . ."); George W. Irving, Jr., *Agricultural Pest Control and the Environment*, 168 SCIENCE 1419, 1419 (1970) ("American agriculture has evolved a monoculture system. . . [T]he large acreages of wheat, corn, or citrus orchards provide inviting environments for pests and diseases of the crops . . ."); Osteen, *supra* note 25, at 267 ("New production systems that increased reliance on monoculture and plant cultivars susceptible to pest damage may have encouraged pesticide use . . ."); Pimentel et al., *supra* note 19, at 277.

¹⁰⁴ See BOSSO, *supra* note 9, at 26.

could now eat their way through the entire apple crop—wiping out the means of survival.¹⁰⁵ Worse, bugs in neighbors' trees would happily munch their way into other farmers' orchards as well, not recognizing the property lines between the orchards. The increasing scale of agriculture and specialization in food production raised standards of living¹⁰⁶ and produced some environmental improvements, such as reducing the amount of land in cultivation.¹⁰⁷ Unfortunately it also made what had been local or small threats from a pest invasion that attacked one piece of the food supply into major problems for specialist producers.¹⁰⁸

Entrepreneurs responded by selling solutions: pesticides. Although there are anecdotes about pesticides being used in ancient Greece and the Roman Empire,¹⁰⁹ the major use of pesticides began in the mid-nineteenth century. Some early pesticides were substances like "Paris Green" and "London Purple," inorganic poisons that required high enough doses to cause acute medical problems for people who ate food with the pesticides still on them.¹¹⁰

¹⁰⁵ Elkana et al., *supra* note 101, at 8 ("The higher the yield and income the farmer aims at, the higher the risks he has to take in his practices, and the greater the need for crop protection advice.").

¹⁰⁶ See, e.g., Green, *supra* note 36, at 172 (noting that in the United States one agricultural worker can produce enough food to feed himself and sixty additional people, using only two hectares of land, while, on average, in developing countries one agricultural worker can produce only enough food to feed himself and two other people using about eight hectares of land); Indur M. Goklany, *Agricultural Technology and the Precautionary Principle*, in AGRICULTURAL POLICY AND THE ENVIRONMENT, *supra* note 11, at 107, 116 (describing benefits of modern agricultural technology).

¹⁰⁷ Had technology, and therefore crop yields, been frozen at 1961 levels, then producing the same amount of crops as was actually produced in 1998 would have required a more than doubling of agricultural land area. . . . This estimate optimistically assumes that the productivity of the added acreage would be the same as that of the original land. . . . Imagine the devastation that would have occurred had agricultural technology been frozen at 1961 levels, while mortality rates continued to drop worldwide in response to advances in public health, hygiene, and medicine, pushing up population. Massive deforestation, soil erosion, greenhouse gas emissions, and losses of biodiversity would have occurred with the more than doubling of the amount of land diverted to agriculture.

Goklany, *supra* note 106, at 110-11.

¹⁰⁸ See Pimentel et al., *supra* note 19, at 279 (noting that there has been an increase in insecticide use on corn due to elimination of crop rotation on forty percent of the American corn crop).

¹⁰⁹ Downer, *supra* note 71, at 1 ("Records of the use of olive oil extracts for blight control by the Greek philosopher Democrates date from 470 B.C. Vine pests were controlled with sulfur fumes by Cato in Italy in 200 B.C.").

¹¹⁰ Green, *supra* note 36, at 165 ("Pesticides before [World War II] were either inorganic compounds such as sulfur, lead arsenate or Bordeaux mixture, or were naturally occurring

Others were “secret formulas” peddled by scam artists that did not do much at all.¹¹¹

This situation meant there were three problems with pesticides that became popular in the late 1800s and early 1900s. First, the pesticides that worked were often capable of causing acute health problems, including death, if people ingested them. These were “Hobbesian” pesticides: nasty, brutish, and acutely toxic. This prompted concerns about residues on foods, a concern largely addressed by improving processing to remove the usually visible residues.¹¹²

Second, some of the pesticides did not work. As with similar problems with the patent medicine industry, the solution was labeling to allow pesticide users to know what was in their products and who had made the product.¹¹³ Thus, labeling reduced the opportunities for scam artists.

Third, in the view of some farmers, people were not using enough pesticides. In economic terms, some people were “free riding” on their neighbors’ purchase and effort to treat their crops. In particular, in the Pacific Northwest, some apple farmers were not spraying, relying instead on their neighbors to control the pest problem.¹¹⁴ Those who were spraying sought help from the government to force their neighbors to spray and some of the early state pesticide laws did exactly that: every apple grower had to spray.

At that time, most of the problems we associate with pesticides today were not being considered—egg shell thinning among bald eagles, trace pesticide derivatives in tissue samples from remote areas, and long-term health effects were not known and were not perceived as problems. The problems that were recognized were also primarily local—it was a neighbor

organic compounds such as nicotine or pyrethrum.”); *see also* BOSSO, *supra* note 9, at 29 (discussing early pesticides and terming early pesticides “rather inefficient, comparably expensive” and terming them “rather brute instruments”).

¹¹¹ JOHN PERKINS, *INSECTS, EXPERTS AND THE INSECTICIDE CRISIS: THE QUEST FOR NEW PEST MANAGEMENT STRATEGIES* 3-4 (1982) (“The commercialization of the insecticide industry was accompanied by substantial fraud including adulterating legitimate products and making extravagant claims for absolutely worthless junk.”).

¹¹² BOSSO, *supra* note 9, at 47-53 (discussing early residue controversies).

¹¹³ BOSSO, *supra* note 9, at 48 (“Farmers feared increasingly that their purchases might be ineffectual or outright dangerous, while chemical makers worried about ‘unbridled competition’ and less scrupulous competitors.”).

¹¹⁴ This section draws on Roger E. Meiners & Andrew P. Morriss, *Agricultural Commons Problems and Responses: Sick Hogs at the Trough*, in *AGRICULTURAL POLICY AND THE ENVIRONMENT*, *supra* note 11, at 19, 29-31 (discussing free rider problem in agricultural pest control).

who likely caused the problem for a farmer, not someone in another state or country.

So what? After all, we do not often use lead, arsenic, or mercury anymore as active ingredients in pesticides and we know a great deal more about long distance transport of pesticides and their impact on wildlife. So why care about what happened in 1910 in Washington State to apple growers? There are three lessons to be learned from this episode:

1. Pesticide Problems Always Have a Local Dimension—They Start with an Individual Making a Decision to Use or Not Use a Pesticide

There may be other dimensions to the problem, but all pesticide problems start with an individual decision to use or not use a pesticide, except when we collectively act to force the use of pesticides. When pesticide use is the result of individual decisions, we need to understand the economic reasons individuals make the decisions they do.

Pesticides serve an important need for farmers, but their useful attributes are not necessarily their problematic attributes. A pesticide that kills only the target pest, for example, is a superior product in some dimensions for both the farmer and the manufacturer to a broad spectrum pesticide that also kills useful insects or plants.¹¹⁵ Yet broad spectrum pesticides were themselves a response to a problem—only a small proportion of an insect population is typically at a vulnerable stage of their life cycle, so persistent pesticides allowed a single application to reach a larger percentage of the population.¹¹⁶ They also reduced farmers' exposure by reducing the number of applications necessary.¹¹⁷ Now that we know more, however, persistence is no longer seen as a purely positive attribute of a product. Changed information sets mean changed preferences.

Pesticide technology continues to evolve and the characteristics of pesticides change over time. New application techniques made possible by new technology reduce the amount of pesticides needed to control pests¹¹⁸

¹¹⁵ MATTHEWS, *supra* note 37, at 1 (noting replacement of older broad spectrum pesticides with "newer more active or selective chemicals"); see Pimental et al., *supra* note 19, at 275 (noting improvement in toxicity of pesticides).

¹¹⁶ BOSSO, *supra* note 9, at 30 (noting advantages of persistence for farmers); MATTHEWS, *supra* note 37, at 20-21.

¹¹⁷ BOSSO, *supra* note 9, at 29.

¹¹⁸ See, e.g., Downer, *supra* note 71, at 4 (noting development of "patch spraying programs" made possible through use of global positioning systems).

and new pesticides often require lower application rates.¹¹⁹ In short, newer is often greener. As we design regulatory regimes for pesticides, we therefore must be careful that we do not distort the market incentive that took us from the Hobbesian world of Paris Green to the less acutely toxic, more effective products available today.

2. The “Right” Answer to Environmental Problems Evolves over Time with Changed Circumstances and New Knowledge

Our views of pesticide use as a social problem have come full circle—people used to worry that pesticides did not kill enough bugs and that not enough people used them. Now we worry that they kill too many things and that too many people use them. This illustrates a larger point that views of appropriate actions with respect to the environment change over time. For example, we are spending private and public money to restore the wolf to areas that in earlier years we spent private and public money to eradicate. Similarly, raptors such as hawks were the target of eradication efforts in the eastern United States in the twentieth century;¹²⁰ more recently we listened to Rachel Carson’s concern about the impact of pesticide residues on raptor health.¹²¹ We now devote resources to protecting eagles and hawks.

We might say, and we can certainly hope, that we are smarter today than our ancestors were, or at least that we know more about the environment, and so are capable of making better decisions today. However, our great, great-grandparents were neither stupid nor environmental barbarians. They made choices that we may no longer agree with about matters we now call environmental management, but given how scarce resources were for them, we know their decisions were made with care. We should presume that future generations may also make different choices than we make and will know more than we do. Our grandchildren may look back with chagrin at some of our choices, just as we do with respect to some of our grandparents’ choices.

¹¹⁹ See Green, *supra* note 36, at 170 (noting that “[t]here is a definite trend towards higher activity in the most recently discovered pesticides” and noting lower application rates of new chemicals).

¹²⁰ See Andrew P. Morriss & Roger E. Meiners, *The Destructive Role of Land Use Planning*, 14 TUL. ENVTL. L.J. 95, 128-29 (2000) (discussing raptor eradication programs as an example of changed environmental mores and success of private conservation).

¹²¹ See CARSON, *supra* note 2, at 110-19.

We are not suggesting that future generations will brush their teeth with DDT powder. The policy prescription that results from this is simply that we should be cautious about adopting one-size-fits-all solutions premised on our knowing what we think now to be the final word on a subject. This is not an argument for what is commonly called the "precautionary principle"¹²² but rather an argument for allowing diversity in environmental practices, premised on the notion that out of the experience with a wide range of practices will emerge new knowledge about the most appropriate practices for various circumstances.

We must tolerate environmental practices we disagree with and tolerate different individuals and different societies making their own choices about the environment, in general, and about pesticides, in particular. By "tolerate" we mean to distinguish between the kind of activity described at this Symposium where the National Resources Defense Council ("NRDC") sought to prevent federal foreign aid agencies from funding use of pesticides banned in the United States in foreign aid programs¹²³ and the attempts to coerce other countries into making tradeoffs of risk and benefit to suit us, for example, by strong-arming them into banning particular pesticides in their countries.¹²⁴ The former can be legitimate as American taxpayers ought not

¹²² See generally INDUR GOKLANY, *THE PRECAUTIONARY PRINCIPLE: A CRITICAL APPRAISAL OF ENVIRONMENTAL RISK ASSESSMENT* (2001) (critiquing application of the precautionary principle in environmental debate and arguing principle requires action rather than delay in some circumstances); see also Cross, *supra* note 39, at 870-76, 886-93 (discussing precautionary principle and pesticides).

¹²³ See, e.g., Thomas Lovejoy, *Global*, 17 *AMICUS J.*, Jan. 1996, at 40 (describing NRDC's role); Ward Sinclair, *Grounding the Medfly Warriors: Lawmakers Protest Use of Banned Pesticide in Guatemala Project*, *WASH. POST*, May 29, 1987, at A23.

¹²⁴ See Roger Thurow, *A Choice of Evils: As a Tropical Scourge Makes a Comeback, So, Too, Does DDT*, *WALL ST. J.*, July 26, 2001, at A1, A6 ("[E]motions reached a boiling point" over the issue, with some groups pushing for an all-out ban. "It was getting to the stage of 'Look at these environmentalists, they don't care about black babies dying in Africa,' says one negotiator, who backed an all-out ban." (citation omitted)); Nityanand Jayaraman, Greenpeace International, *Greenpeace and Other Indian Voluntary Sector Perspectives on the POPs Problem in Asia in the Context of Larger Issues*, at http://www.chem.unep.ch/pops/POPs_Inc/proceedings/bangkok/JAYA.html (last visited Sept. 1, 2003) ("The international negotiations on POPs offers us a chance to rid the planet of DDT once and for all."). Of course, we need not tolerate others causing us harm, which is important because there are serious problems of long distance transport, wildlife accumulation and other impacts of pesticides outside the area where they are used. See Pierre Mineau, *Birds and Pesticides: Are Pesticide Regulatory Decisions Consistent with the Protection Afforded Migratory Bird Species under the Migratory Bird Treaty Act?*, 28 *WM. & MARY ENVTL. L. & POL'Y REV.* (forthcoming Winter 2004).

to subsidize activities elsewhere that our political process rejects as against our interests. The latter is illegitimate because it attempts to prevent other societies from using their own resources to make their own tradeoffs concerning these issues.

Most importantly, we must recognize that most of the time, pesticides' impacts and measures to control them involve tradeoffs. For example, some soil conservation practices increase the need for pesticide use.¹²⁵ Modified spray techniques to reduce drift, such as using coarser droplets to reduce drift, produce other problems including poor impaction and retention characteristics of the droplets.¹²⁶ Pesticide use saves fossil fuel and reduces the amount of land needed to produce food.¹²⁷ Granular pesticides reduce drift¹²⁸ but increase threats to birds.¹²⁹ Pesticides make fruits and vegetables cheaper, improving health from increased consumption of fruits and vegetables.¹³⁰

Recognizing that products A and B each have some good and some bad attributes, for example, means that trading off A for B is rarely a simple decision that will be appropriately made the same way in every circumstance.¹³¹ Yet the central planning approach to pesticides does exactly that.

¹²⁵ See Pimentel et al., *supra* note 19, at 278.

¹²⁶ Downer, *supra* note 71, at 6, 8 (noting "conflict of interest between goals of maximizing efficacy vs that of minimizing environmental contamination"); see also MATTHEWS, *supra* note 37, at 17 (noting tradeoffs); Matthews & Thomas, *supra* note 68, at 975 (noting that coarser spray used to minimize off-target drift reduces efficacy of application within the field).

¹²⁷ See MATTHEWS, *supra* note 37, at 1 ("Without modern technology (including the use of pesticides) tripling world crop yields between 1960 and 1992, an additional twenty-five to thirty million square kilometres of land would have had to be cultivated with low-yield crops to feed the increased human population . . ."); Green, *supra* note 36, at 174 ("[The] use of pesticide may result in considerable overall savings in fossil fuel energy as well as of land."). Green provides several examples. Assuming a ten percent yield reduction of pesticides were not used on corn, for example, he calculates that pesticides save 570 million gallons of oil. Similarly, no till cultivation, which requires increased herbicide use, can save eight gallons of oil per hectare. *Id.* at 175.

¹²⁸ B.J. Butler & L.E. Bode, *Effects of Application Methods on Energy Use*, in ENERGY IN PLANT NUTRITION AND PEST CONTROL, *supra* note 25, at 259, 261; Finney, *supra* note 19, at 69.

¹²⁹ See Mineau, *supra* note 124.

¹³⁰ LOMBORG, *supra* note 1, at 10 ("[S]crapping pesticides would actually result in *more* cases of cancer because fruits and vegetables help to prevent cancer, and without pesticides fruits and vegetables would get more expensive, so that people would eat less of them.").

¹³¹ The same is true of organic produce and what we might call "chemically enhanced" produce. The latter is superior to the former on several dimensions, including but not limited to cosmetic standards. For example, it is good to have fewer worms in apples, because that leads to fewer worms in applesauce, lower processing costs (avoiding the labor needed to remove the worms), and so lower prices for applesauce. Organic foods serve an important market segment, albeit one that is expanding from a small base. That does not mean,

3. Be Wary of Public Good Arguments

The Washington State apple growers who successfully sought to force their neighbors to spray toxic chemicals on their trees were not chemical crazy. Their arguments were essentially the same as the arguments used to justify a wide range of environmental programs today. They did not make the case in exactly these terms, but the essence of the argument was there. The control of pests benefits not only landowners who control pests on their land but also benefits their neighbors, who suffer fewer losses from pests as a result. It benefits all citizens, because it ensures a good steady crop of apples for everyone.

In economics jargon, the private benefit of spraying one's apple trees is less than the social benefit, but the cost of spraying is borne entirely by the farmer who does the spraying. Indeed, these arguments continue to be made about pesticide use.¹³² As a result, the rational apple farmer did not spray "enough"—since he could not capture the full benefit of his actions. This argument appears regularly in the environmental economics literature. For example, it is often claimed that private landowners will not preserve enough habitat because they do not capture the full benefit of the increased wildlife diversity the habitat makes possible.¹³³ Change the words and it is the same argument for almost any program. In short, private benefits and private costs are almost never the same as social benefits and social costs, however those

however, that mandating organic production techniques is justified on environmental grounds.

¹³² See, e.g., Osteen, *supra* note 25, at 269-71 ("With a mobile pest, a farmer might underestimate the damage per pest because some of the damage occurs elsewhere. In essence, the mobile pest is a negative common property resource which causes social and private optimums to diverge"); J. Palti & R. Ausher, *The Place of Pest and Disease Management in the Agricultural Economy, and Its Legal Framework*, in ADVISORY WORK IN CROP PEST AND DISEASE MANAGEMENT, *supra* note 25, at 3, 4 ("The principle reasons why pest and disease control in crops is so often a matter of public interest [include] [p]est and diseases appearing in one farmer's field may well endanger the crops of his neighbors.").

¹³³ See, e.g., Patrick Parenteau, *Rearranging the Deck Chairs: Endangered Species Act Reforms in an Era of Mass Extinction*, 22 WM. & MARY ENVTL. L. & POL'Y REV. 227, 249 (1998) ("Habitat loss is a classic externality." (citation omitted)); see also Donald J. Boudreaux et al., *Talk Is Cheap: The Existence Value Fallacy*, 29 ENVTL. L. 765 (1999) (arguing that contingent valuation, an attempt to place values on common environmental assets, is flawed and should be rejected as a policy making guide to protect environmental law). *But see* ANDERSON & LEAL, ENVIRO-CAPITALISTS, *supra* note 80, at 4-8 (describing in detail how International Paper made significant profits by managing its timber lands for habitat and selling access to recreational users).

might be defined. As a result, we can generate a theoretical public good argument to justify almost any state action.¹³⁴

Our point here is that we should be wary of such justifications and demand thorough exploration of the factual basis of public good arguments whenever we encounter them, because such arguments appear to justify mutually contradictory, but always coercive, actions dependent on what are often rather flimsy factual assumptions and assertions.

B. *Subsidizing Spraying*¹³⁵

The discovery of modern organic pesticides during World War II created a new set of cheap and effective tools. As these first modern pesticides were both broad spectrum pesticides and significantly safer to users than their “Hobbesian” predecessors, they were soon used on a wide range of insect and weed pests. As a result, “[pesticide] [u]sage increased fivefold between 1950 and 1978.”¹³⁶ The earlier free-rider problem remained, however, and agricultural scientists were anxious to apply their new tools against “public” pests such as the gypsy moth as well.¹³⁷ The increased availability of aircraft for spraying after the war opened up the possibility of attacking forest pests and made large scale spraying an option.¹³⁸

USDA sprayed some acreage itself, including public lands. These USDA pesticide spray programs expanded significantly in the 1950s.¹³⁹ One major focus of the USDA programs was gypsy moth control, leading to the spraying of millions of acres of trees in the northeast with DDT.¹⁴⁰ Fire ants in the

¹³⁴ Professor Steven Bradford made a similar point concerning prisoners’ dilemmas: as “the only economics or game theory that most law professors and law students know, and therefore they think that every policy issue in the world involves a prisoner’s dilemma.” C. Steven Bradford, *As I Lay Writing: How to Write Law Review Articles for Fun and Profit*, 44 J. LEGAL EDUC. 13, 21 (1994) (citation omitted). His tongue-in-cheek advice was “[o]nce you’ve created a prisoner’s dilemma, you can forget about it. You’ve justified whatever type of regulation you want to propose, and economics is no longer a problem.” *Id.* at 22 (citation omitted). The same seems to be true of externality and public good arguments.

¹³⁵ This section draws heavily on Andrew P. Morriss & Roger E. Meiners, *Property Rights, Pesticides & Public Health: Explaining the Paradox of Modern Pesticide Policy*, 14 FORDHAM ENVTL. L.J. 1 (2002) and BOSSO, *supra* note 9, at 79-108.

¹³⁶ RODGERS, *supra* note 9, at 399 (citation omitted).

¹³⁷ See *infra* notes 147-56 and accompanying text.

¹³⁸ Oliver L. Wardman & Miles R. Thomas, *Aerial Applications of Pesticides in the United Kingdom: 1978 to 1998*, 56 PEST. MGMT. SCI. 237, 237 (2000).

¹³⁹ See BOSSO, *supra* note 9, at 81-106 (discussing USDA widespread spraying to control the gypsy moths and fire ants and the resulting public opposition in the 1950s).

¹⁴⁰ BOSSO, *supra* note 9, at 82.

southeast also got attention from USDA, with the 1957 Fire Ant Eradication Act leading to a plan to "treat" twenty million acres, with the federal government picking up half the expense to control this pest.¹⁴¹ USDA argued that fire ants were a major threat to agricultural production, animals, and even human life.¹⁴² By the end of the 1950s, however, government spray programs began to provoke some public opposition and the government had begun to restrict some uses of some chemicals, including DDT.¹⁴³

As one might expect, the first publicly-sponsored spraying programs addressed the most urgent needs. As time went on, however, the bureaucrats who benefitted from the expanded sizes and budgets of their agencies and those who profited from the programs found reasons to expand beyond those needs to more marginal cases. This expansion created opposition because as the scale of spraying expanded, so too did the unintended side effects for non-target species and other negative impacts.¹⁴⁴

One important reason for the problems with the public spray programs was the lack of accountability of the agencies involved for the harm they caused. Because USDA was not liable for the harms it caused to private interests, as where it harmed wildlife and domestic animals, USDA did not consider those effects in deciding when and how to spray. To take but one example, USDA often used large scale application methods, such as aerial application, to apply pesticides to huge acreages.¹⁴⁵ This is precisely the worst way to apply pesticides if you are concerned with minimizing environmental side effects. For example, the appropriate dose varies from field to field.¹⁴⁶ Uniform spraying thus results in overapplication to some fields. Instead of large scale applications, spot spraying is an important means of reducing environmental losses from pesticides.¹⁴⁷ Had USDA been liable for its

¹⁴¹ BOSSO, *supra* note 9, at 87-88.

¹⁴² CARSON, *supra* note 2, at 162.

¹⁴³ BOSSO, *supra* note 9, at 97-98, 100-01.

¹⁴⁴ *Id.* at 84-85.

¹⁴⁵ *See, e.g., id.* at 82 (describing the aerial application of DDT in the case of the gypsy moth). USDA also played an important role in developing aerial application methods. *See id.* at 30 ("The USDA refined aerial spraying techniques during the war, which brought a revolution of its own because farmers no longer needed to walk along the furrows, laboriously applying arsenicals or leads by hand.").

¹⁴⁶ J. Palti & R. Ausher, *Crop Value, Economic Damage Thresholds, and Treatment Thresholds*, in *ADVISORY WORK IN CROP PEST AND DISEASE MANAGEMENT*, *supra* note 25, at 48-49 ("[F]ield-to-field variation will necessitate separate prognoses for each field and orchard, even when these are close neighbours [sic].").

¹⁴⁷ *See* F. Van Den Berg et al., *Emission of Pesticides into the Air*, 115 *WATER, AIR, & SOIL POLLUTION* 195, 196 (1999).

trespass to the dissenting property owners whose property it sprayed, it would have been forced to scale back the large scale applications in favor of spot spraying. As a result, respecting property rights of land owners could have produced a major improvement in environmental consequences without any central direction or even consensus on the rationale for opposing the spray programs. In short, had property rights been respected, even a few “cranks” could have prevented the environmentally damaging and costly, large scale, aerial spray programs.

As the negative impacts began to become clear, USDA’s partners began to refuse to participate. For example, when a Georgia veterinarian reported that a dieldrin spray aimed at fire ants caused the deaths of more than one hundred cattle, increasing numbers of farmers across the south refused to pay for their share of spraying costs.¹⁴⁸ Even the Alabama legislature withdrew funding for spraying in 1959 over concerns about the impact on the state’s wildlife population.¹⁴⁹ USDA responded with a “sale” on spray programs, cutting the price by offering the chemicals for free to those who would take them¹⁵⁰ and continuing to spray in some areas without local consent.¹⁵¹ This opposition meant that USDA was reaping less of a political reward for its spray activities, leading to reduced agency interest in the programs, but the programs had by now created their own supporters: chemical companies selling pesticides to USDA, applicators applying them, and spray program bureaucrats administering enhanced budgets.

The most famous spray campaign example is USDA’s Long Island attack on the gypsy moth, a critically important piece in the development of the modern environmental political movement. During the 1950s, USDA decided to spray millions of acres on Long Island, despite scant evidence of gypsy moth presence.¹⁵² In some respects, and considering the general atti-

¹⁴⁸ BOSSO, *supra* note 9, at 102.

¹⁴⁹ *Id.*

¹⁵⁰ *Id.* (“[I]n Texas the USDA literally gave heptachlor away to any property owner willing to use it.”).

¹⁵¹ *Id.* (quoting a USDA spokesman).

¹⁵² The government’s own experts’ testimony at the trial during which Long Island residents attempted to block the spray program established that the threat from gypsy moths on Long Island was minimal. The director of the Plant Pest Control Division of USDA, for example, testified that prior to the spraying the infestation on Long Island was “light and scattered.” C.C. Alexander, Notes on DDT Case 18 (1958) (unpublished manuscript on file with authors and available at the Cornell University Library) (testimony of Emory D. Burgess). Nonetheless, USDA sprayed 600,000 acres to deal with forty-seven foci of infestation. *Id.* Testimony at the same trial also established that using aerial spraying, USDA could not avoid spraying the property of individuals who objected, as well as streams and ponds. *Id.* at 6, 8

tude of the times, this program was undertaken for "environmental" reasons: USDA wanted to save the forests on Long Island from the voracious gypsy moth.¹⁵³

From the point of view of Long Island residents, USDA's methods left a great deal to be desired.¹⁵⁴ First, the spray used was a mixture of DDT and oil, which stuck to the trees, and blanketed the area.¹⁵⁵ Unfortunately, it also stuck to cars, swimming pools, and houses.¹⁵⁶ Residents claimed there were large fish kills caused by the indiscriminate spraying of ponds and streams as well as forests.¹⁵⁷ Human health concerns relating to contaminated milk from cows grazing on sprayed fields were also raised.¹⁵⁸ These objections culminated in the 1957 suit filed by Robert Cushman Murphy, an authority on birds and curator-emeritus of the Museum of Natural History, together with a group of other Long Island residents seeking to enjoin the spraying program. Using common law property and tort theories, the plaintiffs challenged USDA's ability to deprive them "of property and possibly lives without due process of law and [take] their private property for public use without just compensation" and claimed the spraying program was a "trespass upon the persons and property of the plaintiffs"¹⁵⁹

The plaintiffs lost the first suit and the spraying continued.¹⁶⁰ In rejecting the plaintiffs' claim for relief, the trial judge ruled that the support of public agencies for the spray program outweighed the plaintiffs' property rights.¹⁶¹ The judge found that "[s]uch a formulation of informed opinion could not be ignored . . . and the research conducted by the trained staffs of both Federal and New York State departments was directed to an intelligent program designed to deal with the realities of a perplexing situation."¹⁶² With a

(testimony of Boyd R. Opheim and Alexander Barrett Klots) (A USDA employee testified that "it would be inconvenient and expensive to eradicate gypsy moths by ground sprays, though not impossible."). Another witness testified that ground spraying cost \$25 per acre compared to \$1 per acre for aerial spraying. *Id.* at 18 (testimony of Emory D. Burgess). The contracts for the aerial spraying were arranged in Washington, not on Long Island. *Id.* at 21 (testimony of William L. Popham).

¹⁵³ BOSSO, *supra* note 9, at 84-85.

¹⁵⁴ *Id.* at 82.

¹⁵⁵ *Id.*

¹⁵⁶ THOMAS R. DUNLAP, DDT: SCIENTISTS, CITIZENS, AND PUBLIC POLICY 87 (1982).

¹⁵⁷ *Id.*

¹⁵⁸ *See id.*; *see also* Murphy v. Butler, 362 U.S. 929, 930 (1959) (Douglas, J., dissenting).

¹⁵⁹ Murphy v. Benson, 151 F. Supp. 786, 789 (E.D.N.Y. 1957).

¹⁶⁰ *Id.* at 792; BOSSO, *supra* note 9, at 83.

¹⁶¹ Murphy, 151 F. Supp. at 792.

¹⁶² *Id.*

significant public benefit shown by agency testimony and the failure of the plaintiffs to show that there was a threat of irreparable damage to them in excess of what the community would suffer from the gypsy moth, the judge refused the injunction.¹⁶³

The group tried again the following year, armed with more evidence of dangers of DDT exposure.¹⁶⁴ The court dismissed the plaintiffs' claims yet again, this time holding that they only complained of an "annoyance" rather than alleging sufficient harm to warrant damages.¹⁶⁵ Their annoyance was outweighed by the greater good of the spray program: "The rights of individuals are not limitless. Individuals must yield to the requirements of the public as a whole."¹⁶⁶ Although the plaintiffs appealed, the Second Circuit Court of Appeals quickly held the case moot on the grounds that the spraying program was over for the year.¹⁶⁷

The trial record gives some insights into the marginal benefit of the government spray programs at this point: by the government's own estimates at trial, it dealt with a "light and scattered" set of fewer than fifty infestation foci of gypsy moths by spraying six hundred thousand acres at a cost of at least \$600,000.¹⁶⁸ This is an extraordinary sum since, even using the government's own cost figures for ground spraying costs, the entire problem could have been avoided if those forty-seven foci occupied fewer than twenty-four thousand acres.¹⁶⁹ Since a "light and scattered" infestation could hardly have been anything close to twenty-four thousand acres, the government chose a means of conducting the program that harmed the Long Island plaintiffs and cost it more money than the alternative. Why? We can only speculate that the opportunity to spray met other needs for USDA, such as rewarding the contractor who did the spraying.

¹⁶³ *Id.*

¹⁶⁴ See *Murphy v. Benson*, 164 F. Supp. 120 (E.D.N.Y. 1958).

¹⁶⁵ *Id.* at 126, 129.

¹⁶⁶ *Id.* at 128.

¹⁶⁷ *Murphy v. Benson*, 270 F.2d 419, 420 (2d Cir. 1959). The Supreme Court denied certiorari, although Justice William O. Douglas dissented from the denial, arguing the issue was not moot because spraying could resume and the damage from DDT was not understood well enough for the courts to dismiss the possibility of danger. *Murphy v. Benson*, 362 U.S. 929, 931-35 (1960) (Douglas, J., dissenting).

¹⁶⁸ See Alexander, *supra* note 152, at 18 (testimony of Emory D. Burgess).

¹⁶⁹ The government estimated ground spraying costs at \$25 per acre. Alexander, *supra* note 152, at 18. Since the government was spending \$600,000 on aerial spraying, anything less would have been a savings. Dividing \$600,000 by \$25/acre yields twenty-four thousand acres. So long as the government had to spray less than twenty-four thousand acres to get the forty-seven foci, it would have saved money.

In economic terms, USDA's overall behavior is easy to understand. Congress and the agency had incentives to maximize the net political benefits of spraying. The first spray programs were conducted where the marginal political benefits of spraying were largest, such as controlling malaria and other insect-borne diseases. As the program expanded, however, spraying extended into areas with lower marginal political and environmental benefits such as gypsy moth control. Similarly, the spraying programs were first done where the marginal political costs of spraying were lowest (over swamps) and expanded into areas where the marginal political costs increased (inhabited areas). Even if nothing else had changed, this dynamic would have eventually led to the spray programs' expansion to a point where the benefits fell below the costs of continuing to expand the program, including the opportunity cost of foregone alternative uses for the tax money spent on the spray programs. Increased public opposition, as the public learned of the health and environmental damages the sprays could be causing, brought a more rapid decline in the total political benefits. As a result, Congressional and agency support for them also fell.

There are two important lessons from the spray programs of the 1950s and 1960s: respect property rights and publicly-provided goods are often oversupplied, with negative consequences for the environment.

1. Respect Private Property Rights

The programs caused major problems because the government refused to respect private property rights. If USDA had been required to respect property owners' rights, it could not have continued its mass eradication programs of aerial spraying once the environmental costs became clear. Only by overriding property rights was the environmental damage caused possible.

This illustrates a crucial point about government action: governments are effective because they can coerce people, and coercion is sometimes cheaper than buying agreements. Coercion lowers the price of coordinating activity. As environmental economist Ian Wills notes, "[i]t is government's coercive power that makes the difference; planners have no other major advantage over market exchange in coordinating production and consumption."¹⁷⁰ Respecting property rights, by requiring governments to obtain consent or compensate rights holders for takings of private property, is a

¹⁷⁰ WILLS, *supra* note 11, at 104.

critical constraint on the capture of the coercive power of government by special interests.¹⁷¹

2. Oversupply of Publicly Provided Goods

The natural consequence of providing the spray as a public good meant that the programs would continue to expand as USDA bureaucracy and interest groups that benefitted from the programs sought to keep the benefits they received from the political process. As a result, we need to think seriously about agencies being captured before entrusting policy decisions to them. When policies offer benefits concentrated on a few while dispersing the cost over many, we should expect to see such captures resulting in undesirable program expansion. The government spray programs are a clear example of this problem. An important protection against such over-expansion of government programs is forcing the government to respect property rights. Where governments must compensate property owners for lost rights, actions taking the rights are put “on budget” and considered by the agencies involved.¹⁷²

C. DDT & Malaria¹⁷³

Malaria is a significant public health problem today in much of the developing world.¹⁷⁴ DDT is a particularly valuable weapon in the fight

¹⁷¹ See RICHARD A. EPSTEIN, *TAKINGS: PRIVATE PROPERTY AND THE POWER OF EMINENT DOMAIN* 332 (1985); see also Royal C. Gardner, *Invoking Private Property Rights for Environmental Purposes: The Takings Implications of Government-Authorized Aerial Pesticide Spraying*, 18 STAN. ENVTL. L.J. 65 (1999) (examining the implications of property takings challenges in response to government aerial sprayings).

¹⁷² See Andrew P. Morriss & Richard L. Stroup, *Quartering Species: The “Living Constitution,” the Third Amendment, and the Endangered Species Act*, 30 ENVTL. L. 769, 807-08 (2000) (describing importance of putting environmental programs “on budget”).

¹⁷³ See generally Morriss & Meiners, *supra* note 135 (expanding the material presented here).

¹⁷⁴ Hundreds of millions of people suffer from malaria and millions of families lose infants to malaria—one researcher termed it the equivalent of “filling seven Boeing 747s with children, and then crashing them, every day.” Amir Attaran et al., *Balancing Risks on the Backs of the Poor*, 6 NATURE 729, 729 (2000). Malaria kills a child every thirty seconds. Children who survive malaria past infancy “suffer an average of six bouts each year, making [it] the most common cause of school absenteeism.” UNITED NATIONS CHILDREN’S FUND, *ROLLING BACK MALARIA* 4 (1999), available at http://www.unicef.org/publications/pub_rollback_malaria_en.pdf (last visited Sept. 16, 2003). Adult sufferers miss an average of ten working days a year. Martin H. Villet, *Malaria Epidemic in KwaZulu-Natal and DDT: The Facts* (2000), email posted on Malaria Foundation International, at <http://www.malaria>.

against malaria and other insect-borne diseases.¹⁷⁵ Unfortunately, the ban on DDT use in many countries and growing international pressure to end its use¹⁷⁶ and manufacture worldwide have allowed malaria to make a comeback. The result is that a disease on the way to extinction is back in strength.

Controlling malaria requires controlling mosquitoes because the disease is transmitted by parasites carried by mosquitoes.¹⁷⁷ The key to malaria control is thus to kill infected mosquitoes before they can transmit the parasite to humans through bites, not using DDT handicaps these malaria control efforts. Before DDT was in use, malaria was estimated to infect three hundred and fifty million people in 1952.¹⁷⁸ With the use of DDT, the infection rate fell by ninety-seven percent by 1969, largely because of DDT sprayed inside homes and on mosquito breeding sites.¹⁷⁹ Now, after the wide use of DDT was discontinued for environmental concerns, the disease is nearly back to where it was fifty years ago.¹⁸⁰ The British medical journal, *The Lancet*, recently reviewed the evidence on the impact of stopping the use of DDT and concluded that when DDT spraying is ended, malaria's incidence

org/news227.html (last visited Sept. 15, 2003).

¹⁷⁵ Attaran et al., *supra* note 174, at 729 (noting that DDT is "one of the few affordable, effective tools against the mosquitoes that transmit malaria").

¹⁷⁶ For example, environmental pressure groups have succeeded in making DDT unavailable for malaria control in many countries, while conceding that DDT's usefulness against malaria requires "special attention and caution." Klaus Topfer, Working Together for a POPs Treaty for the Next Millennium, Opening Remarks at the Third Session of the Intergovernmental Negotiating Committee for a Treaty on Persistent Organic Pollutants (Sept. 6, 1999), at http://www.pops.int/documents/press/prel_spch/SpeechTopfer.htm. The number of countries using DDT has been whittled down to nineteen. See INT'L POPS ELIMINATION NETWORK, DDT & MALARIA: ANSWERS TO COMMON QUESTIONS 1 (2001), at <http://ipen.ecn.cz/index.php?z=&L=en&k=download&r=default&id=6> (last visited Sept. 15, 2003). The pesticide is produced in only two countries and is becoming difficult to obtain. *Id.* The UN seeks a global ban by treaty. Governing Council Dec. 13C, U.N. Env't Programme, 19th Sess., paras. 2, 4 (1997), available at http://www.chem.unep.ch/pops/gcrops_e.html ("[I]nternational action, including a global legally binding instrument, is required to reduce the risks to human health and the environment arising from the release of the twelve specified persistent organic pollutants [including DDT].").

¹⁷⁷ See Titus Bradley, *Malaria and Drug Resistance*, at <http://www.micro.msb.le.ac.uk/224/BradleyBradley.html> (last visited Sept. 7, 2003).

¹⁷⁸ UNITED NATIONS CHILDREN'S FUND, *supra* note 174, at 6.

¹⁷⁹ *Id.*

¹⁸⁰ *Id.*

rises markedly.¹⁸¹ The disease has returned to areas in which it previously had been eradicated.¹⁸²

DDT is not the only means of combating malarial mosquitoes. The other means are strikingly less effective, however. The current international anti-malarial effort, Roll Back Malaria (“RBM”), for example, uses “insecticide-treated mosquito nets, mosquito coils, repellents and other materials; early detection, containment and prevention of malaria epidemics; and strengthening of local capacity to monitor malaria in affected regions.”¹⁸³ The difference between RBM and DDT use is clear from RBM’s goal: merely to reduce infant mortality from the disease, not its incidence, by fifty percent by 2010.¹⁸⁴ Compared to the ninety-seven percent reduction in disease achieved decades ago with DDT, RBM’s goal seems painfully inadequate. Moreover, the alternatives promoted by RBM cost more and are less effective than DDT.¹⁸⁵ For example, mosquito sleeping nets cost \$5 to \$10 each,¹⁸⁶ making them expensive for people in countries where per capita personal income is measured in the hundreds of dollars per year. And, because the nets require continual retreatment (soaking the nets in insecticide, something that must be done by the nets’ owners), there is increased human exposure.¹⁸⁷

One reason DDT appeared to be so harmful in the 1950s and 1960s was due to its widespread use in heavy dosages, mostly from government spray campaigns but also from overuse by private sprayers who had not learned proper application techniques. Heavy doses produce more environmental

¹⁸¹ D.R. Roberts et al., *DDT House Spraying and Re-Emerging Malaria*, 356 LANCET 330, 331 (2000) (“When a malaria-endemic country stops using DDT, there is a cessation or great reduction in numbers of houses sprayed with insecticides, and this is accompanied by rapid growth of malaria burden within the country.”).

¹⁸² *Id.*

¹⁸³ UNITED NATIONS CHILDREN’S FUND, *supra* note 174, at 8.

¹⁸⁴ See Roll Back Malaria homepage, at <http://www.rbm.who.int/newdesign2/> (last visited Sept. 15, 2003).

¹⁸⁵ Villet, *supra* note 174. Delegates to a World Health Organization conference on DDT use in Africa in Harare, Zimbabwe in 2000, for example, issued a statement expressing the “deep concerns of the participating member states on the possible economic and health implications of any restriction made on DDT use for malaria control.” Malaria Found. Int’l, *Delegates’ Report of the Regional Consultation to Prepare African Countries Towards Reduction of Reliance on DDT for Malaria Control*, Harare, Zimbabwe, Feb. 8-10, 2000, available at <http://www.malaria.org/ddtreduceaf.html> (last visited Sept. 15, 2003); see also The WHO Cabinet Project, *Roll Back Malaria Financial Situation* (Dec. 1, 1999), at http://mosquito.who.int/docs/3gpm_financial.htm (outlining the expenses of treating malaria without using DDT).

¹⁸⁶ UNITED NATIONS CHILDREN’S FUND, *supra* note 174, at 3.

¹⁸⁷ See *id.*

impact.¹⁸⁸ Even if DDT is sprayed from the air for mosquitoes, the volume and frequency used today is far less than common agricultural practices in earlier years.¹⁸⁹ The primary use today, however, is a much more limited one—an interior spray in houses in areas at risk for malaria.¹⁹⁰

Why do so many people oppose the use of DDT to control a major health threat such as malaria? The most public opponents of DDT use, even if they concede a limited role for it in the present, are United States environmental pressure organizations.¹⁹¹ Their case against DDT for malaria control is that any use will lead to expanded uses for illegitimate purposes.¹⁹² Such an argument proves too much, however, since it is true of almost any potentially dangerous substance that a total ban can reduce harm from illegitimate use.¹⁹³ A more likely motive, however, is that the initial ban on DDT remains an important symbolic victory for environmental pressure groups. The ban of DDT in the United States took a lengthy and bitter fight and a major triumph for the new environmental movement. Indeed, the Environmental Defense Fund (now Environmental Defense), one of the most

¹⁸⁸ Attaran, *supra* note 174, at 729 (“The fault for this lies in the massive agricultural use of DDT. Dusting a single 100-hectare cotton field, for example, can require more than 1,100 kg of DDT over 4 weeks.”(citation omitted)).

¹⁸⁹ See Malcolm Gladwell, *The Mosquito Killer*, NEW YORKER, July 2, 2001, at 42, 50.

¹⁹⁰ Attaran, *supra* note 174, at 729 (“The current practice is to spray the interior surfaces only of houses at risk, leaving a residue of DDT at a concentration of 2 g/m² on the walls, ceiling and eaves, once or twice a year. Half a kilogram can treat a large house and protect all its inhabitants.”). Indoor spraying was already a crucial part of the antimalaria campaign by the 1950s. Gladwell, *supra* note 189, at 50.

¹⁹¹ A review of websites offered by major environmental organizations (Audubon, EDF, NRDC and WWF) indicates nothing but an historical interest in DDT. It is simply to be listed as a chemical that everyone knows is bad. Greenpeace sponsors protests at the few factories in nations where DDT is still produced. Roger Bate, *Without DDT, Malaria Strikes Back*, SPIKED SCI. (Apr. 24, 2001), at <http://www.spiked-online.com/Articles/000000005591.htm>. The World Wildlife Federation is also pushing to eliminate all use of DDT. Richard Tren & Roger Bate, *When Politics Kills: Malaria and the DDT Story* 23 (2001), at <http://216.156.132.11/PDFs/Malaria.pdf>. To be fair, there has been a quiet pulling back from the advocacy of a total ban by most environmental organizations which now argue for a transition to other “less damaging” pesticides.

¹⁹² Roberts et al., *supra* note 181, at 331 (“[E]nvironmentalists are still seeking a global ban arguing that if DDT is produced for use in improving public health, it will also be used for agriculture and lead to global pollution of the environment.”(citation omitted)).

¹⁹³ Indeed, the argument is strikingly similar to that made against the medical use of marijuana, or even studying such uses, a position many environmental pressure group members would presumably disagree with because of its implications for reducing individual freedom. See, e.g., *The War on Drugs: Fighting Crime or Wasting Time?*, 38 AM. CRIM. L. REV. 1537, 1560-61 (2001) (comments of Congressman Bob Barr in response to a question on why he opposes medical marijuana referenda in the District of Columbia).

effective groups, grew out of the initial campaign against DDT spraying on Long Island.¹⁹⁴

There are others who benefit from restricting or eliminating DDT use, including the manufacturers of substitute pesticides, which are more expensive and less effective than DDT.¹⁹⁵ DDT is cheap because it has long since lost patent protection and can be made by anyone without payment of royalties.¹⁹⁶

This instance of environmental advocacy seems to have won approval of powerful pesticide companies because it allows them to sell their more expensive insecticides. The replacement of DDT by organophosphate, carbamate, or pyrethroid insecticides is commonly proposed even though price, efficacy, duration of effectiveness, and side-effects ([for example] unpleasant smell), are major barriers to their use in poor countries.¹⁹⁷

There are several lessons from the malaria story.

1. Symbolic Politics Have No Place in Government Environmental Policy

Symbolism is a critical part of political discourse. Making decisions based on symbols is not unusual in political decision-making. Symbolic politics are, however, a strikingly bad means of allocating resources through the political process. In the case of DDT and malaria, for example, symbols kill.

Symbolic acts are, on the other hand, perfectly appropriate for individuals. Consumers can demand products that are pesticide-free, even if such products have no objective benefits¹⁹⁸ and are inferior to fruits and vegetables grown with pesticides in other dimensions, solely because they want to

¹⁹⁴ DUNLAP, *supra* note 156, at 142-200 (discussing history of DDT suits and EDF).

¹⁹⁵ Attaran, *supra* note 174, at 730 (explaining that Malathion, the next cheapest alternative, costs three times as much to apply as DDT).

¹⁹⁶ See Morriss & Meiners, *supra* note 135, at 26.

¹⁹⁷ Roberts et al., *supra* note 181, at 331.

¹⁹⁸ We offer this example purely for the sake of argument. There may well be such benefits. Our point is that even if there are not, the act may still be a valid one as an individual symbolic action.

support pesticide-free agriculture as a symbolic gesture. In this case the individual bears the costs of her decision: if organic produce is not superior to non-organic produce, she will be paying more for an inferior product. The problem occurs when some people use government's coercive power to impose costs on others to achieve a symbolic act. In that case, the special interest group members do not bear the full costs of their actions, and consequently buy too much of the symbol. Where the symbols have real costs, as with DDT and malaria, this is unacceptable.

2. One-Size-Fits-All Policies Are Inferior to Federalism

Solutions that work for one place may not work for another, as local conditions matter. Local knowledge matters in many ways. For example, the vulnerability of groundwater to pesticide contamination "depends on the unique combination of local conditions."¹⁹⁹ As USDA pesticide official Allan Jennings noted in 1988, many pesticide problems vary from location to location creating "the issue of how to effectively restrict pesticide usage *where the problems exist*."²⁰⁰ Removing pesticide decisions to the lowest possible level is thus superior to centralizing them so long as local decision makers have adequate information available to them. Producing and disseminating information is, therefore, an important means of improving pesticide decision making.

D. Drift

The objective of pesticide delivery can generally be regarded as "the placement on targets of just sufficient of a selected active ingredient to achieve a desired biological result with safety and economy."²⁰¹ Unfortunately, pesticides applied to a crop on one property sometimes end upon another property, where they can cause harm.²⁰² Herbicides commonly used on cotton, for example, are harmful to corn. Applying a pesticide to one crop can result in harm to a neighboring field's crop when the pesticide drifts across the

¹⁹⁹ Allan L. Jennings, *EPA Regulatory Thrusts and Impact on Pesticide Usage*, in IMPROVING ON-TARGET PLACEMENT OF PESTICIDES 31, 33 (Agric. Research Inst. ed., 1988).

²⁰⁰ *Id.* at 34 (emphasis added).

²⁰¹ Downer, *supra* note 71, at 5 (citation omitted).

²⁰² Drift has significant environmental impacts:

boundary between the fields and gets on the wrong crop. Reduced yields are the most common result in those circumstances. Urban-rural boundaries also produce drift complaints where agricultural sprays contaminate urban gardens and property. Beyond losses in application, other emissions of pesticides that contribute to drift also occur, including emissions from the plant, and volatilization of the pesticide after application.²⁰³ These losses can be substantial as well, with up to fifty to sixty percent lost in this fashion.²⁰⁴ As with other problems with pesticides, reducing drift involves tradeoffs between solving one problem and increasing another.²⁰⁵

Disputes over drift have been a feature of agricultural life since spraying began.²⁰⁶ Drift problems are the result of the relatively low efficiencies of pesticide application, whereby only small percentages of the active ingredient reach the target pests.²⁰⁷ Many states have well-developed bodies of tort law dealing with drift damage. The surprising thing about pesticide drift cases is that there are so few of them, given the volume of pesticides applied to American crops. One reason for this is that many state governments provide services to help resolve disputes over drift.

One of the authors (Morriss) worked for the Texas Department of Agriculture ("TDA") during law school as an intern. TDA had then recently passed from the control of the rural wing of the state Democratic party, and a particularly obtuse Agriculture Commissioner named Reagan Brown, to the control of the left wing of the state Democratic party, with the election of Jim

A key issue is the risk of "spray drift" beyond the field boundary, especially if there is another crop susceptible to a herbicide, there is surface water or a ditch which could be contaminated by the pesticide, or there are bees downwind of insecticide-treated fields. Protection of hedgerows around fields is also of crucial importance to avoid contaminating the habitat of important populations of natural enemies. Field boundaries are also important habitats for game birds and conservation of other wildlife.

MATTHEWS, *supra* note 37, at 14 (citations omitted).

²⁰³ See generally Van Den Berg et al., *supra* note 147 (discussing the various types of pesticide emissions and relevant dynamics).

²⁰⁴ *Id.* at 213.

²⁰⁵ MATTHEWS, *supra* note 37, at 19 ("There can be a conflict between optimising the spray quality for efficient application of a pesticide and endeavoring to minimise the risk of drift.").

²⁰⁶ See Morriss & Meiners, *supra* note 135 (discussing drift cases).

²⁰⁷ See, e.g., MATTHEWS, *supra* note 37, at 18 (discussing this problem); G.A. Matthews, *Improved Systems of Pesticide Application*, 295 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON (SERIES B, BIOLOGICAL SCI.) 163, 163 (1981) ("Sometimes over 99% of the pesticide fails to reach the intended target.").

Hightower.²⁰⁸ Hightower had made a name for himself by campaigning against the fire ant program's indiscriminate use of pesticides.²⁰⁹ Hightower generally concentrated on positive aspects of the agency, such as increasing marketing of Texas produce.²¹⁰ He also inherited the main state pesticide regulatory efforts—then locked in a 1950s-era bureaucracy. Hightower wanted change in pesticide policy to satisfy his urban, environmentalist constituency, but he also needed to not alienate the agricultural community, which was highly suspicious of him, if he wanted to be reelected, so he tread fairly cautiously.²¹¹

As part of the internship, Morriss went on some pesticide investigations with the chief inspector, Al Hernandez. During a typical investigation, they would visit some neighboring farmers, one of whom alleged that the other's pesticides had drifted onto his fields, causing harm to his crops. This sort of thing was common as there were hundreds of such complaints a year resulting from having adjacent crops that required incompatible pesticides.

On each investigation, the same thing would happen. When everyone had gathered in a field to look over the alleged damage, and shook hands all around, each person would glance down at the others' hands. Usually everyone but Morriss would have a large, gold, Texas A&M ring.²¹² Morriss's lack of a ring would most times cause a visible step back by the others, with a further step back when Hernandez would mention Morriss was a Yankee law student attending the University of Texas. The chill would only go away when Hernandez assured everyone that despite this failing, he considered Morriss "OK." The community of interest that the Aggie ring signified was critical to TDA's ability to play a constructive role in these situations.

Second, the TDA inspectors played the role of impartial arbiters and documentors of events—sometimes all it took was the inspector opining that it indeed did look like some broadleaf herbicide had gotten onto the cotton

²⁰⁸ For a general discussion of Hightower's approach, see Ronald B. Taylor, *Texas' New-Style Agriculture Commissioner Jim Hightower Carries His Message of a New Populist Movement Nationwide*, L.A. TIMES, Dec. 19, 1985, at 40.

²⁰⁹ See William Schneider, *An Insider's View of the Election*, ATLANTIC ON-LINE, July 1988, available at <http://www.theatlantic.com/politics/policamp/insider.htm>; see also Jan Reid, *The Fire Ant*, TX. MONTHLY.COM, available at <http://www.texasmonthly.com/ranch/readme/ants.php> (last visited Oct. 24, 2003).

²¹⁰ Taylor, *supra* note 208.

²¹¹ *Id.*

²¹² For a discussion of the history of the Aggie ring, see The Ass'n of Former Students of Texas A&M Univ., *Aggie Website*, at <http://www.aggienetwork.com/ring/timeline.aspx> (last visited Sept. 15, 2003).

field as evidenced by the swath of sickly looking plants for a couple of hundred feet into the field or noting that nearby weather stations reported gusting winds on the day the applicator had sprayed the wheat field, to satisfy everyone that some compensation was owed.

Most of the incidents went no further—TDA served as recorder, which helped with insurance companies, and expert adjudicator, making sure that a bad crop was not improperly blamed on a neighbor instead of the drought or bad seed. Once in a great while, lawsuits were filed. In those cases, usually involving larger amounts of alleged damage, the tort system worked reasonably well.

The cases that did not fit within the “easy-to-solve-amongst-us-Aggies” paradigm were the urban exposure cases. These usually happened on the borders of town and country, where individuals experienced drift onto their gardens, laundry, houses, and persons. Missing from these cases was the reciprocal nature of rural life, where one drift incident went from my field to yours, the next from yours to mine, and so on. Townspeople might not use pesticides in their gardens, and certainly did not do so from airplanes, and felt understandably strongly about being sprayed with what they saw as dangerous poisons that they often felt no one had any business using.

Town and country cases were harder to resolve, in part because it was harder to resolve the value of the harm. Agreeing amongst farmers on the value of a ten percent reduction from ten rows of cotton is easier than agreeing about the value of the loss of an organic garden between an organic gardener who has gone to considerable trouble to create one and a farmer who thinks organic foods are for fools who do not value progress. TDA never figured out a good way to resolve those cases. The values asserted were incompatible and the most the agency could offer was to allow the parties involved to vent their feelings to the inspectors and, hopefully, facilitate the parties in working something out.

There are three lessons from our drift “fable.”

1. Many Pesticide Problems Have Local Dimensions as Well as Potentially Having Broader Dimensions

Sometimes we focus on the global problem of residues in Antarctic penguins and forget that those residues generally got there by migrating off the property of someone who thought the pesticides were doing some good on her property. When those pesticides migrate, they often pass through the

property of an immediate neighbor long before dispersing into the environment and making their way to Antarctica and the penguins. Those local problems are not the complete set of problems, but they are the easiest set to solve. This suggests that perhaps we should begin with institutions that address local problems first before tackling the really hard ones. Solving the local problems also can significantly reduce environmental harm from pesticide use: solving boundary problems, for example, has major environmental benefits.²¹³

2. Local Institutions Do a Good Job of Solving Local Problems Because Local Institutions Have Knowledge About Local Conditions— Knowledge That is Important to Understanding the Problem

The local TDA inspectors and the farmers knew the reputations of the different applicators, their equipment, soil conditions, and so on, information that enabled them to make judgments that were impossible for people in Austin, let alone Washington, D.C., to make. The people in Austin and Washington might have been smarter, known more science, or had more degrees, but they lacked the local knowledge needed to make good decisions in a cotton field near Floydada, Texas. Further, those farmers were right to look for an Aggie ring on TDA employees, and right to pull back when they did not see one. The lack of a ring meant someone was not part of their community and should not, could not have been trusted without some further indicia of trustworthiness. That person lacked the local knowledge necessary to solve their problems.

Markets can solve problems: entrepreneurs have come up with methods to prevent drift problems. New technologies to reduce drift include shrouds, wind foils, air-assisted sprayers, variable-rate nozzles, chemical additives to mixtures to that change spray characteristics, and others.²¹⁴ The possibility of

²¹³ Finney, *supra* note 19, at 70.

Perhaps the most dramatic short-term ecological improvements will arise from increased attention to the management of field boundaries and other uncropped land. These areas are crucially important to wildlife and sensitive management, often involving use of appropriate selective herbicides, can lead to rapid and sustainable improvements in species diversity.

Id.

²¹⁴ Downer, *supra* note 71, at 6; Matthews, *supra* note 207, at 171 ("In the future, on larger farms, there may be advanced vehicles with computer controls of flow rate, droplet size, charge: mass ratio and swath width, the appropriate chemical being selected in relation to the

solving these problems lures new entrants into the market.²¹⁵ Substantial improvements in controlling drift can be made by adopting these techniques. Other improvements are also reducing other environmental problems.²¹⁶

In short, the environmental problems caused by pesticides are largely the result of off-target deposition. Drift onto neighboring crops is the most acute form of this;²¹⁷ bioaccumulation of the pesticide in non-target species is another. Reducing one, however, can lead to reductions in others as well. Moreover, the size of the losses from both application drift and post-application volatilization are sufficiently large given the price of pesticides, so that reducing them offers a significant opportunity for profit.

3. Value Conflicts are Hardest to Solve

An important lesson concerns the hard problems that come from conflicting values—both the urban-rural divide and the organic gardener-cotton farmer divide, are a product of fundamental conflicts in values. The contrasting images in the 1970s debates over pesticides of rural pesticide users volunteering to drink or bathe in their sprays to demonstrate their safety and organic produce advocates clad in natural fibers warning of “silent

input of crop monitoring data.”).

²¹⁵ See, e.g., Harold C. Simmons, *The Role of Industry in Developing Innovative Spraying Equipment*, in IMPROVING ON-TARGET PLACEMENT OF PESTICIDES, *supra* note 199 (describing interest of Parker Hannifin Corp., a company with \$2 billion annual sales, in market despite previous lack of experience in pesticides because of record in developing spray equipment).

²¹⁶ Finney, *supra* note 19, at 69.

[N]ew products are being developed with physiochemical properties which will make them less mobile and less persistent in the environment. Substantial improvements are also being made to formulations and packaging, especially a trend away from liquids to solid granular formulations, which should significantly reduce accidental point-source contamination of the environment through spillage.

Id. Technological change also causes shifts in application methods. Aerial application, which produces more off-target deposition and drift than most other methods of application, became common after World War II. Improvements in ground spraying equipment led to a later decline in aerial application. Wardman & Thomas, *supra* note 138, at 243.

²¹⁷ One estimate suggested that thirty percent of the quantity applied is typically lost to drift in aerial foliar insecticide applications. OFFICE OF PESTICIDE PROGRAMS, ENV'T'L PROT. AGENCY, A STUDY OF THE EFFICIENCY OF THE USE OF PESTICIDES IN AGRICULTURE 10, fig. 1 (1975). Ten percent is estimated to be lost to volatilization, leaching and surface transport, fifteen percent to application off the target crop, and forty-one percent to off the target insect, but on target crop. *Id.* Clearly there are major efficiencies to be gained by improving these figures.

springs” was not evidence that rural America was something out of the movie *Deliverance*²¹⁸ or that all those concerned with pesticides had yet to get over Woodstock. The dispute was caused by different value choices, different information sets, and different weighting of risks and benefits. Those are hard problems—and they are not made easier to solve by handing them to the federal government to resolve in a winner-take-all fashion through the political process. Such problems are best left to levels of government closer to communities likely to share values and to decentralized decision making that allows different solutions for different communities.

4. Federalism Works

Moreover, voluntary methods can reduce such conflicts. Application technique plays a significant role in the proportion of a pesticide application that reaches the pest and the proportion that ends up off-target and “in” the environment. Off-target drift is waste, something that all participants have an incentive to reduce. Doing so can even yield marketing benefits: Consumer pressure for lower chemical use has led to “Consumers Charters” in Australia, for example, in which growers pledge to reduce their use of chemicals and comply by reducing off-target waste.²¹⁹

In addition to value conflicts, pesticide use presents problems for tradeoffs. Our final lesson from the drift fable is that tradeoffs exist.

5. Tradeoffs Exist

Controlling drift is a problem that requires trading off different aspects of control. Most obviously, stopping drift generally requires substituting the risk of less than complete coverage of the target field for the risk of drift. This can be accomplished by simple methods (stop spraying before the edge of the

²¹⁸ DELIVERANCE (Warner Bros. 1972).

²¹⁹ Jones et al., *supra* note 36, at 176. Jones and his co-authors note that significant reductions in bioregulators can be achieved through research into more efficient application methods.

There should be a reduction of the amount of active bioregulator ingredient used per hectare by at least 25% as a result of the use of more efficient spray application technology. Bioregulator application dosages could be reduced by a further 25% as a result of spraying at the most effective time. There is evidence to show that correct application timing can allow the reduction of the dosage of bioregulator used by up to 50%.

Id. at 179-80.

target field, do not spray when the wind is blowing hard) or more complex changes (altering droplet size). Less obviously, some of these methods can increase other environmental harms. Reducing off-site drift (“exo-drift”), for example, may entail techniques that increase on-site-but-off-target application (“endo-drift”) through changes in droplet size that alter leaf retention.²²⁰

This is an example of larger problems in pesticide policy. The decisions are not simply dichotomous: food or environment, bugs or people, poison or savior. Using any particular pesticide is a choice not to undertake alternative actions. It is rare that any one choice is purely beneficial or harmful for the environment. Persistent pesticides reduce exposure to applicators but increase problems for wildlife; broad spectrum pesticides kill more pests but also have more impact on beneficial insects; no till agriculture reduces erosion but increases herbicide use. The “environmental” choice is likely to differ from place to place and time to time.

IV. PRINCIPLES

To put these lessons to work, we offer five principles for pesticide policy and environmental policy more broadly:

- Avoid the nirvana fallacy.
- Facilitate the use of local knowledge. Government’s role is to facilitate information sharing and the development of local institutions.
- Recognize existing explicit and implicit property rights claims.
- Solve the easy problems first.
- Get the incentives right.

Using these principles would allow the development of a new pesticide policy that we argue would have less environmentally damaging consequences than our current policy.

The first step is to avoid both the false nirvanas of regulatory solutions and the despairing and equally false apocalyptic predictions that have haunted American pesticide policy. A realistic assessment of institutions is vital to an effective policy. Assuming that EPA will be able to amass and digest the

²²⁰ Matthews & Thomas, *supra* note 68, at 975 (“To avoid increasing endo-drift and also minimise the risk of downwind exo-drift there is a need for optimisation of droplet size within the crop and for ensuring that droplets impact on foliage within the treated area, so that minimal dosages are effective.”).

relevant data and decide the status of every pesticide in use on every crop in a coherent and rational way in a very short time is one example of a nirvana fallacy. Assuming that pesticide users will simply stop using pesticides while this process goes on is another.

Moreover, even if EPA could respond coherently to such demands, centralizing regulatory decision making costs us the local knowledge that is critical to making good decisions. For example, allowing American preferences on DDT to dictate its use in malaria-ridden countries is a recipe for bad decisions. Within the United States, making decisions in Washington, D.C. (or Austin, Texas or Columbus, Ohio) loses important information available in Junction, Texas and Columbia Station, Ohio. Some information can be known in Washington, Austin, and Columbus—scientific information about the impact of a chemical on birds, for example. But knowing things about specific fields also makes a difference in the environmental impact of pesticide use. Pushing decision making towards local institutions is thus usually preferable to central planning. That does not mean that the federal government has no role. It can play an important part in facilitating information flow, developing information, and fostering local institutions.

Increases in knowledge take time and the recognition of the importance of issues. For example, not until the 1960s and 1970s did agricultural economists focus on the economic threshold for pesticide use.²²¹ Once such work began, however, it quickly grew more sophisticated.²²² More knowledge can mean problems are solved.

In addition to fostering local institutions generally, pesticide policy should foster the most local institution of all: property rights. We should be attempting to find ways to define new property rights where they do not exist. Technology can help with this;²²³ the most important thing is to favor solutions that recognize existing property rights claims and foster the creation of new ones. Migratory bird problems, for example, might be addressed by giving title to specific bird flocks, identified through DNA sampling and microchip implants, to bird watchers. Other aspects of environmental protection for migratory birds have been solved through private initiatives built around property rights, such as the prairie pothole program run by

²²¹ Osteen, *supra* note 25, at 268.

²²² *Id.* at 269.

²²³ Richard S. Cahoon & Ron Herring, *Biotechnology, Intellectual Property, "Bioproperty" and Novel Schemes for Wild Biota Conservation*, in *THE TECHNOLOGY OF PROPERTY RIGHTS* (Terry L. Anderson & P.J. Hill eds., 2001).

Ducks Unlimited.²²⁴ Governments can facilitate such solutions in a variety of ways.

We should not let the existence of hard problems that we cannot immediately solve prevent us from tackling the easy problems. There are many in pesticides, starting with the destructive role of agricultural subsidy programs around the world. Transforming the debate over such programs into an environmental issue could be helpful in overcoming the entrenched special interest that block change in the United States and abroad. Solving some of those problems, such as drift and overly-intensive farming in response to the subsidy program structure, may solve some of the harder problems for us.

Finally, the most important principle is to get the incentives right. Incentives matter and they can have a major impact. The agricultural chemicals business is highly competitive.²²⁵ The development of new techniques that reduce pesticide use, saving the farmer money and reducing environmental impacts, is increasing as entrepreneurs recognize these techniques as a source of profits.²²⁶ The competitive edge the companies gain is a powerful motivating force for improving pesticides by reducing environmental impacts. For example, over- and under-application is a problem where equipment is not precisely calibrated. "Monitors that sense speed and flow rate and have inputs for application width can continuously display the application rate. Servo-control units that automatically control the application rate with changes in travel speed are now available also."²²⁷ Market pressures are also changing pesticide use, as consumers demand foods that meet higher standards of safety.²²⁸ Pesticide companies can offer package services to control pests rather than simply selling particular chemicals, allowing them greater control over conditions of use and providing them with the opportunity to control for resistance development and other factors.²²⁹

²²⁴ See Jonathan H. Adler, *The Ducks Stop Here? The Environmental Challenge to Federalism*, 9 S.Ct. ECON. REV. 205, 237 (2001).

²²⁵ Green, *supra* note 36, at 176.

²²⁶ See, e.g., Blazquez et al., *supra* note 30, at 117 ("In the United States, large-scale adoption of [computerized pest management] schemes may be expected in the near future, as commercial firms move into the pest information delivery field at an accelerating pace.").

²²⁷ Butler & Bode, *supra* note 128, at 264.

²²⁸ See, e.g., MATTHEWS, *supra* note 37, at 5 ("In practice, those marketing the produce (the supermarkets and food processing companies), are having a greater influence on pesticide use by insisting on specific management programmes.").

²²⁹ See E.E. Bernet, *The Project Approach to Crop Protection*, 295 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON (SERIES B, BIOLOGICAL SCI.) 199 (1981) (describing Ciba-Geigy's approach to selling such package services).

V. CONCLUSION

For much of the last century, pesticide use in the United States has been regulated under a central planning approach. Whether it was apple growers in the Pacific Northwest not using enough pesticides or farmers in the 1970s using too many, governments at all levels have attempted to dictate use decisions based on the model of a central regulator assessing the situation and choosing what was "best" for individuals. Those decisions have been largely made in a vacuum ignoring the impact of other government programs on pesticide use, with a result of a contradictory mess.

Markets, property rights, and common law offer an alternative way to think about pesticide policy. Decentralizing decision making and focusing on incentive effects of government programs can solve some of our problems with pesticides without the undesirable impacts of the central planning approach.