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PESTICIDES

An Economic Perspective on Outdoor Residential Pesticide Use

SCOTT R. TEMPLETON, DAVID ZILBERMAN, AND SEUNG JICK YOO
Department of Agricultural and Resource Economics
207 Giannini Hall
University of California-Berkeley
Berkeley, CA 94720-3310

Outdoor residential pesticide use has different economic motivations than agricultural pesticide use. During the past 20 years, pesticides for nonstructural pests have been applied on residential landscapes of about 50% of all U.S. households. But the number of people who pay for professional treatments has been growing. Households that use outdoor pesticides are more likely to have yards, bigger or better-quality yards, lower pest tolerances, more pestiferous surroundings, or less concern about risks of pesticidal exposure. Professional pest control becomes more attractive as the costs of household time, equipment, or exposure increase or as the benefits of professional time, expertise, equipment, or a restricted pesticide increase. In general, households are less likely than farmers to use pesticides, read labels, and take precautions. They apply herbicides at higher rates and insecticides at lower rates than most farmers. These behavioral differences reflect differences in the objectives and degree of market orientation of pest control, the scale of operations, and regulation. Our economic perspective, together with scientific information on pest management, can be useful for creating better pest management policies to reduce adverse environmental or public-health impacts.

Outdoor residential pesticide use can create adverse environmental and human-health impacts. Actual problems have included the pollution of stormwater runoff and treated sewage effluent with two widely used insecticides (*1*), accidental poisonings of humans (*2*) and pets (see Chap. 29 in *3*), loss of beneficial pests and earthworms (see Chap. 28 in *3*), bird kills and reproductive impairment (see Chap. 27 in *3*), and the development of pest resistance (see Chap. 28 in *3*). The possible increased risk of cancer and other adverse health effects on bystanders and applicators of nonaccidental exposure to yard pesticides is a public concern and the subject of an ongoing scientific debate. Some studies confirm a basis for concern (for example, *4, 5*), yet others do not (see Chaps. 22 and 23 in *3*). The Food Quality Protection Act of 1996 requires that EPA not only address risks to adults, but also to children, and to set tolerances for pesticide residues in food based on exposure not only from food itself but also nondietary sources, such as residential landscapes (*6*). Government officials have also become more involved in promoting safer use and urban integrated pest management (*7*). To be effective, these public efforts should be grounded in an understanding not only of biological but also economic reasons for pest control and pesticide use on residential landscapes. By emphasizing benefits and costs, economic analyses of

agricultural pesticide use and regulation have contributed to policy making (*8*, *9*).

This article analyzes outdoor residential pesticide use from an economic perspective. The analysis uses a conceptual model that contrasts with the a familiar model of agricultural pesticide use. Patterns of do-it-yourself and professional pesticidal treatments on yards are characterized and qualitatively analyzed in terms of expected, or perceived, benefits and costs. Differences in treatment thresholds, market shares of expenditures and quantities applied, application and disposal methods, and application rates between farmers, households, and yard care professionals are also documented and analyzed for differences in expected private benefits and costs.

Private benefits and costs

Farmers manage pests to improve profits or maintain stable profits. The expected private benefits of agricultural pesticide use are improvements in yield or crop quality that result in additional or more stable revenue, less production expense, or both. The expected private costs include expenses for the chemicals, equipment, application labor, and regulatory compliance. A farm pest population reaches an action threshold when the expected benefits of using pesticides to control the damage exceed the expected costs. At the threshold or beyond, farmers control damage with pesticides provided that no alternative damage control is more profitable. Action thresholds decrease and application rates increase if, for example, crop prices increase, ecological conditions favor pest growth, crops are more sensitive to damage, or pesticide prices decline (*10*).

Outdoor residential pest control is a production activity performed or coordinated by consumers. Households manage nonstructural pests outdoors to enhance their use of lawns, gardens, patios, and other outdoor landscape features that make up yards. The expected benefits of outdoor pesticide use include more comfort and safety from pests and better-looking yards (see Chaps. 2 and 3 in *11*). People enjoy better-looking yards for aesthetic pleasure, stress reduction, playing sports, and other forms of recreation (*12*, *13*). Better-looking yards also tend to increase property values (*13*, *14*). Pesticides used on gardens can increase the quantity or improve the quality of edible produce or flowers. If they prevent mortality, pesticides enable the treated plants to continue to abate noise, moderate temperature, and serve other environmental functions in the yard (*12*) at the possible expense of undesired plants or landscapes that might also serve these functions. In these cases, pesticides help people to avoid the costs of replacing plants and, for shade trees, added cooling expenses as well (*15*). The private costs of outdoor pesticide use include time and money for purchase, preparation, application, storage, and disposal of the chemicals. In some cases, private costs also include exposure to the pesticide used. As a rule, government officials cannot afford to monitor household compliance with pesticide labels, and households do not expect to pay fines for violating the directions on them.

Yard appearance or a pest population reaches an action threshold and induce pesticidal treatment when the perceived benefits exceed costs. Stronger attitudes toward yard amenities, less concern about exposure, stronger desires for comfort and safety from pests, and more expensive yard plants create incentives for households to use pesticides and increase application rates. In general, private incentives for pesticide use are less financial, more psychological, and less regulatory for

householders than for farmers. As a result, action thresholds and application rates are likely to differ between them, even for the same crop.

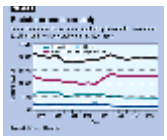
Do-it-yourself treatments

Outdoor pesticide demand derives from perceived benefits of yards. Pesticides likely to be used most are those that, for a given cost, increase perceived benefits the most. Pests most likely to be targeted are those that cause the most expected net damage. A National Home and Garden Pesticide Use Survey indicates that 41% of all households in the United States applied at least one type of pesticide outdoors at least once in 1990 (*16*). A larger share of households applied insecticides (35.5%) than herbicides (14%) because people tend to treat ants, mosquitoes, and other arthropod nuisance pests more frequently than weeds or arthropods that harm yard plants (*16*, *17*) and were about equally likely to treat plant-harming arthropods or weeds (*16*). Households give top priority to controlling these nuisance pests because they care most about their own safety (*18*), some of these pests impair outdoor recreation, and damage done by weeds or other arthropods to yard plants is usually aesthetic (*17*).

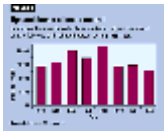
Households spent $1.0-$1.3 billion in 1995 on outdoor pesticides that they applied (Figures 1-3). Figure 1 also depicts the relative importance of supply sources. In particular, nurseries, lawn and garden centers, and hardware stores, which have traditionally supplied the most product information, accounted for 20% of retail sales of do-it-yourself, outdoor pesticides in 1995. Mass merchandisers provide less product expertise (Chap. 2 in *3*) but have the largest market shares; discount stores, buying clubs, grocery stores, and others accounted for 37%, and home centers accounted for 43% of retail sales in 1995.

Accounting for household expenditures

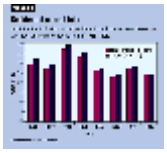
Do-it-yourself application has changed over time. Annual nationwide surveys indicate that real expenditures of households for do-it-yourself, outdoor insect control varied from year-to-year in a range of $1.0-$1.8 billion during 1988-1995 (Figure 3). The average percentage of households that controlled insects outdoors was 26% from 1992 to 1995 but 34% from 1988 to 1991 (Figure 4). Since the percentage of households that control insects outdoors without any insecticides is almost zero (*19*), Figures 3 and 4 also indicate outdoor insecticide use. Nominal expenditures for indoor and outdoor insecticides grew during 1979-1995 but did not keep pace with inflation during 1979-1987 (Figure 2). The sharp increase from 1987 to 1989, in spite of declines in amounts of active ingredients, reflects a switch in data sources and not a statistically meaningful change, according to Aspelin (*20*).



Pesticide expenditures study



Ups and downs of insect control

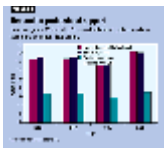


Residential control falls

Real expenditures for herbicides decreased in most years during 1979-1995 (Figure 2). But the amount of herbicidal active ingredients applied by households to yards increased from 33 million lbs. in 1979 to 47 million lbs. in 1995 (*20*). Herbicides accounted for 39% of all pesticides applied by households in 1979, and this share steadily increased to 64% in 1995. Amounts of insecticidal and fungicidal active ingredients applied by households and the corresponding shares of total use decreased during 1979-1995 (*20*). The herbicide share would be even larger if only outdoor insecticides were considered; herbicides constituted 78%, whereas insecticides only constituted 19% of total outdoor use in a typical year in the early 1990s (*21*). Real expenditures for fungicides and other pesticides also did not increase during 1979-1995 (Figure 2). Lack of growth in expenditures for pesticides and declines in amounts of insecticides and fungicides applied do not mean, however, that the overall market for yard pesticidal treatments has stagnated. The market for professional applications must be considered.

Professional treatments outdoors

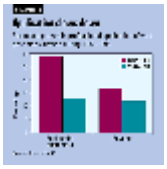
The percentage of all households in the United States that hired a lawn care company or other agent to apply nonstructural pesticides outdoors was 12% in 1990 (*16*) and no more than 14-16% during 1993-1996 (Figure 5). According to a national survey (*n* = 1307) conducted by Gallup for the University of California at Berkeley, 11.5% of all households in the United States hired professionals to apply pesticides or fertilizers or both to their yards. The households surveyed spent about $3.1 billion for these chemical treatments in 1995. EPA data (*21*) indicate that herbicides constituted 79% of all active ingredients applied by professionals, insecticides, 19%, and fungicides, 2%, in a typical year in the early 1990s. If deflated by the Consumer Price Index (*22*), annual expenditures for chemical treatments, lawn mowing, and other professional services were about $7 billion during 1993-1996, except for 1995 (Figure 5).



Demand for professional support

Households demand professional pesticidal treatments for various economic reasons. First, the professional's time, expertise, or access to a restricted pesticide is sufficiently beneficial to merit the expense. Second, some householders want to reduce their exposure to pesticides (*18*). Third, the hired applicator's time or specialized equipment is sufficiently less costly than the household's time or rental expense for similar equipment. Time costs of households tend to increase with salaries of adult members. Consistent with these hypotheses are the observations that people who hire professionals tend to have larger yards or incomes (*23*, *24*).

The application of fertilizers and pesticides on yards is the main service provided by lawn care operators (*25*). Lawn care operators have the largest market share among professional applicators, others of which include landscape maintenance companies, arborists and tree service companies, gardeners, landscape contractors, and structural pest controllers. The lawn care operator segment of the industry grew dramatically from its inception in the late 1960s to the mid-1980s (Chap. 10 in *11*, *25*). Increases in household discretionary income, the demand for leisure, and the desire for high-quality lawns motivated this growth (*25*). Do-it-yourself applicators were initially the largest source of customers for lawn care operators (*26*). Since the mid-1980s, industry leaders (n = 7) report that the rate of growth in the number of customers was about 50% lower during 1992-1996 than during 1987-1991 but revenue growth decreased less severely (Figure 6). In addition to former do-it-yourself applicators, people who had previously not treated their lawns and owners of new homes were equally important sources of growth during the past 10 years (*27*). The growth in the number of customers does not necessarily mean that the total amount of pesticides applied by professionals has increased. The Professional Lawn Care Association of America reports "a trend of fewer and less toxic pesticides applied by professionals per acre of an average yard" (*27*). National data are needed to track trends in professional application of yard pesticides.



Application slows down

Overall pattern of outdoor treatments

Notwithstanding the rise and related fall in shares of professional and do-it-yourself application, the overall percentage of households that demand outdoor pesticidal treatments has not changed substantially over the past 20 years. Between 1976 and 1977, 21.4% and 38.7% of all households in the United States indicated that their members or professionals had applied pesticides to their gardens and other parts of the

yard, respectively (28). Hence, depending on the unreported overlap between those who had both gardens and other yard areas treated, no less than 38.7% and no more than 60.1% in that year demanded pesticidal treatments. In the mid-1980s, 39.4% and 9.6% of single family residences in the United States had do-it-yourself and professional treatments of lawn chemicals, respectively (25). In 1990, 41% to 53% of all households had yards or other outdoor areas treated with at least one type of pesticide (16). This range reflects the unreported overlap between those who hired professionals and applied pesticides themselves. In 1995, 50% of all households had their yards treated with pesticides, fertilizers, or both, according to our national survey (n = 1307). A stable 50% implies that about 14 million more yards were treated with pesticides in 1995 than in 1975, given the growth of 28 million households during that period (29).

Roughly half of all households do not have outdoor pesticidal treatments. Twenty percent of all households do not have private lawns (16). Among those with yards, people are less likely to apply outdoor pesticides as their incomes decrease because they are less likely to have yards of sufficient size or quality, and a larger portion of their income would necessarily be spent for the treatments (30). In some areas, pest populations do not reach action thresholds because of climate; areas with cooler or drier climates generally have fewer disease and insect problems than areas with warmer or more humid climates (31). Household attitudes about what is a pest vary (32). A minority of householders, about 12% in two surveys (17, 18), believe pesticides are unsafe and are less likely to use them (33). The time costs of nonchemical alternatives are lower for householders who value time less or have more free time. These factors can explain why some households use alternatives or tolerate pests (16, 18).

Comparisons with agricultural pesticide use

Action Thresholds: Given 99 million households in the United States in 1995 (29), about 49.5 million households had at least one type of pesticide applied outdoors because yard appearance or nuisance pest populations reached action thresholds. The median planted yard size was 0.12 acre in our sample (n = 824). In contrast, at least one pesticide was applied on 1.5 million farms in 1992 (20), and the mean farm size for harvested cropland was 198 acres (34). In particular, farmers treated 96% of their acres of vegetables with herbicides in 1992; at least 95% of corn, soybeans, and fall potato acreage with herbicides in 1993; 90% of vegetables with insecticides in 1992; 97% of fall potatoes with insecticides in 1993; and at least 92% of fruit and nut acreage with at least one pesticide in 1991 (35). As a rule, then, action thresholds for at least one type of pest are lower for farmers than for householders. Thresholds are lower because potential income losses of pest damage are hundreds to thousands of times larger for farmers than for householders. Income losses from not using pesticides and using some nonchemical alternatives instead were estimated at 10%, on average, of food crop value in 1974 (8), or $2872 of harvested crop production (36). In addition to these scale effects of potential pest damage, the popularity of low- or no-tillage for soil conservation is another reason why weed thresholds are lower for agricultural producers than for households. Cultivation for weed control is not an option with reduced tillage systems.

Market Shares: Annual retail expenditures for pesticides applied by householders

ranged from 25% to 33% of expenditures for agricultural pesticides between 1979 and 1995 (*20*). Quantities of active ingredients of conventional pesticides applied by households were about 10% of the quantities applied by agricultural applicators during the same period (*20*). On the one hand, these percentages overstate the importance of pesticidal treatments on yards relative to farms because the data for household insecticide use include indoor uses. According to data compiled by Hatton (*37*), 55% of total household expenditures for insecticides in 1995 was for outdoor insecticides. On the other hand, these percentages understate the importance of pesticidal treatments of residential landscapes relative to farms because they exclude data on professional application, which are included with data on application by nonagricultural professionals (*20*). In a typical year in the early 1990s, lawn care operators applied about 71% of the quantity of pesticidal active ingredients that households applied to yards (*21*).

Decision Making, Application, and Disposal Procedures: Integrated pest management requires an understanding of the local ecosystem, knowledge of biological controls, and close monitoring of pest populations. However, a sizable minority of households lack knowledge about beneficial insects (*17*, *38*). In general, most households tend not to be primarily concerned with horticulture or entomology when making decisions about outdoor pest control (Chap. 2 in *11*), treat symptoms of pest problems without suitable information about the causes (*13*), and tend to be unfamiliar with nonchemical pest management (*18*). Moreover, a significant minority of households do not read pesticide labels, follow the directions, or obtain information about precautions and proper uses against specific pests when reading labels (*18*, *28*, *33*, *38*). Furthermore, a significant minority of households apply more than recommended doses (*33*), and a majority do not wear protective clothing (*16*, *18*, *33*). Finally, about 1.1 to 1.4 million households in the United States disposed of excess diluted-from-concentrate pesticides in sinks, toilets, streets, gutters, or sewers in 1990 (*16*). Although this number is small, small amounts of some pesticide residues can harm certain aquatic organisms (e.g., *39*). Treating symptoms and making decisions based on yard appearance or the presence of nuisance pests can make more sense to householders than to farmers for a number of reasons. First, acquiring reliable information entails fixed costs that might be higher for householders than for farmers because the greater variety of managed plants in yards (Chaps. 6, 7, 10 in *11*) might create a greater variety of pest problems (Chaps. 6, 18 in *40*). Moreover, farmers can spread these fixed costs over areas hundreds of times larger than yards. Second, monitoring pests and diagnosing emerging pest problems entail variable costs. Variable costs per acre are probably lower for farmers than householders because government support of integrated pest management, and markets for integrated pest management professionals are larger and older for agriculture than horticulture (Chaps. 2, 6, 8, and 10 in *11*, *35*). Third, the expected income loss due to pest damage is usually smaller and, unless the residential property is for sale, less immediately important for householders than for farmers. Fourth, householders care more about landscape appearance and comfort from nuisance pests because they use their yards for aesthetic pleasure and recreation, whereas most farmers do not use their fields for these purposes.

The expected benefits of not reading a label or following the required procedures include less mental effort, time and, for some precautions, physical discomfort and

financial expense. The expected costs of not following label procedures can include greater pesticide expense or exposure, but rarely the regulatory fines that are possible in agriculture. These benefits and costs are likely to vary with household and yard characteristics. People who value their health less, have less income, or cannot read are more likely to choose the comfort or financial savings of not wearing protective clothing over the risk of greater, perhaps unperceived, exposure. Some people are more likely to overapply because, for example, the minor income loss of wasted pesticide is less important as their income increases or because they are more concerned about storing leftovers than other people. Pesticides that are underapplied can fail to improve appearance and prevent plant mortality, whereas overapplication often does not threaten aesthetics or plant health.

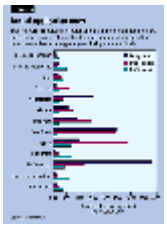
In contrast, integrated pest management has been adopted on at least 50% of cropped acres of numerous fruits, nuts, vegetables, and field crops for at least one of the three major pest types: insects, weeds, and diseases (*35*). Moreover, 100% of lettuce growers and the majority of growers of strawberries and tomatoes used gloves, eye or face shields, and respirators when prescribed for mixing and loading or for application (*41*). Bigger potential income losses from waste and larger expected penalties for label violations mean that farmers have stronger market and regulatory incentives than householders to scout pests, read labels, apply recommended amounts of appropriate pesticides, and take prescribed precautions. Agricultural applicators are also more likely to take precautions because some pesticides they use are more toxic and even restricted for outdoor residential use.

Application Rates: Pests and pesticide use vary with geography. But comparisons between farm and yard pesticide use at the national level are common (e.g., see *2*). In almost all cases, these comparisons are empirically grounded in the work of von Rumker et al. (*42*). They found that households in suburban areas of Philadelphia, Pa., Dallas, Tex., and Lansing, Mich., applied from 5.3 to 10.6 lbs. of active pesticidal ingredients per acre of all lawn and garden space, treated or not, in 1971. They asserted that these application rates were much higher than those for farms and concluded that suburban lawns and gardens probably received the heaviest applications of pesticides of any land area in the United States. These assertions and more recent comparisons of annual application rates between farms and yards should be interpreted carefully. If, for example, more insecticides are applied on treated yards than certain treated farms per year, the insecticides applied are not necessarily the same, nor are the frequencies of application.

More recent data paint a more complicated picture, in which differences in annual application rates averaged over different agroclimates reflect differences in the economic purpose that plants and associated landscapes serve, the inherent sensitivity of crops to pest damage, and the degree to which the benefits threatened by pests are tangible and of immediate concern. On the one hand, for example, treated urban landscapes received eight times the amount of active ingredients of 2,4-D and other phenoxy herbicides that treated rural landscapes received per acre in 1992 (Figure 7). Moreover, households and lawn care operators had higher herbicide application rates than all farmers, except growers who treated citrus, rice, and sugarcane, for a typical year in the early 1990s (Figure 8). The current application rates for golf courses and lawn care operators should be slightly lower than those in Figures 7 and 8 because in

1993, the EPA restricted herbicide use on turf to no more than two broadcast applications per year and no more than 2 lbs. of active ingredient per application (*43*). Higher annual application rates on turf occur for one or more of these reasons: weeds on lawns and other urban landscapes are a serious visual nuisance for households and urban institutions that can afford weed control; weeds do not directly harm the appearance of most tree fruit, nuts, and grains and accordingly create relatively low potential losses per acre; farmers can mechanically control weeds; and the growing season is shorter for most annual crops than for turf grasses, which are perennials.

Comparing herbicide use



Annual application rates

Treated urban landscapes received eight times the amount of active ingredients of 2,4-D and other phenoxy herbicides that treated rural landscapes received per acre. The rural and urban averages are the weighted means of the specific rural and urban uses listed and color-coded. All data are for 1992. On the other hand, household residents and lawn care operators applied less, not more, active ingredients of insecticides and fungicides per treated acre than pesticide-using producers of citrus fruits, other tree fruits, nuts, melons, vegetables, and cotton (Figure 8). Insects and fungi cause substantially less potential financial damage per acre to lawns than to these agricultural crops. That is, certain insects and fungi directly harm the appearance of fresh produce; lawns are less susceptible than food crops to physical harm from these pests; consumers are less tolerant of cosmetic injury in commercially grown produce than in home-grown produce; damage from arthropods or fungi is harder to notice on lawns than on commercial produce; and revenues per acre of these crops are probably higher than any imputable revenue from most yards. However, householders and lawn care operators apply more insecticides and fungicides per acre than growers of most grains and soybeans because processors of these crops can tolerate aesthetic damage and, perhaps, these crops are less susceptible than perennial plants to physical harm from arthropods or fungi.

Differences in annual application rates of outdoor residential pesticides also exist between applicators too (Figure 8). Annual insecticidal and fungicidal application rates are lower for lawn care operators than for householders. The financial incentive to avoid waste is stronger for lawn care operators than householders: The scale of

operation and, thus, potential loss from overapplication, is bigger for professionals than do-it-yourselfers. Moreover, lawn care operators apply insecticides or fungicides primarily to control pests that harm lawns, trees, or shrubs but not to control garden pests or nuisance arthropods, except in Florida and southern California, where they are as likely to control exterior nuisance pests as lawn, tree, or shrub pests (*26*).

However, lawn care operators applied almost 50% more herbicides per acre per year than household residents (Figure 8). Lawn care operators tend to treat lawns more frequently per year than householders. Their customers tend to have higher incomes and demand fewer weeds in their lawns than do-it-yourself applicators. A weed-free lawn is important to customers. Failure to eliminate weeds is a primary cause of customer complaints (*25*). Moreover, preventive broadcast treatments are more profitable than curative spot treatments because of the fixed costs of travel time, equipment, and customer coordination. Spot treatments are more economically done by household residents, unless their time is extremely costly.

Policy implications

Outdoor pesticidal treatments improve expected private welfare but not necessarily social welfare because the perceived private benefits do not necessarily exceed the social costs, which include external costs. External costs occur when users and makers of outdoor residential pesticides create, but do not pay for, adverse environmental or human-health side effects. For example, nonprescribed preparation, application, storage, or disposal undoubtedly contribute to poisonings of nontarget organisms, including humans. Although probably smaller than external costs of agricultural pesticide use for the whole United States, the external costs of outdoor residential pesticide use might be greater in certain geographic or socioeconomic locations. For example, differences such as fewer precautions taken by householders than farmers, higher annual herbicidal application rates than those of most farms, and higher annual insecticidal application rates than those of most grain farms might make concentrations of pesticides higher in water near treated yards than some treated farms. The detection of more pesticides and higher concentrations of them in an urban watershed near Atlanta than in two agricultural-forestal watersheds in southwest Georgia illustrates this possibility (*44*). Also, population densities that are higher near treated yards than treated farms away from the urban fringe imply that, if all other factors were constant, more people would be potentially at risk of exposure through nondietary routes from outdoor residential pesticides than from agricultural pesticides.

Our economic perspective can be used to analyze the benefits and costs of government intervention to solve actual and potential problems. For example, the benefits of effectively monitoring unlicensed applicators for hire or banning over-the-counter sales to households of pesticides that are not ready-to-use would include profit increases for licensed applicators and fewer accidental exposures of nontarget organisms, including humans. These benefits would be greatest in neighborhoods where people are most likely to hire unlicensed applicators or are most likely to buy pesticide concentrates. The costs of limiting over-the-counter pesticides to ready-to-use products would include the forgone net private benefits of the restricted pesticide concentrates minus the increase in net benefits of the more demanded ready-to-use product(s). These costs might be greater in higher-income neighborhoods because people there tend to own more valuable yards, have lower action thresholds, and

apply pesticides at higher rates.

As a rule, outdoor residential pesticide use requires less time, money, and knowledge than less-toxic pest control and is often more efficacious in the short run. Integrated pest management is time- and information-intensive (Chaps. 2 and 18 in *40*). Numerous local educational programs about alternative controls and problems with current (mis)use have been tried (e.g., Chap. 18 in *40*). However, to engender adoption of residential integrated pest management and reductions in pesticide (mis)use, policies should not only provide public education, but also one or more of the following financial incentives: less expensive professional pest scouting, lower prices for beneficial organisms, less toxic pesticides through product subsidies or government-sponsored technical innovations, and higher prices for more toxic pesticides through product taxes or registration fees. These price changes would have to be substantial to overcome the money-, time-, and information-saving advantages of more toxic products and current practices. Although more research on residential integrated pest management and regulation is needed, our economic perspective on outdoor residential pesticide use can already help in evaluating government intervention and making it more effective.

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