PRESCRIBED BURNING IN THE SOUTH:  
STATUS, COSTS, AND CHANGES IN  
THE LEGAL ENVIRONMENT  

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ABSTRACT  

About 4.4 million acres of forestland in the South are prescribed burned each year. In some States, the area burned has been decreasing steadily. Some industrial owners plan to burn less in the future because of increased regulation and liability risks associated with burning, higher prices and better utilization standards for wood residues, and the availability of chemical and mechanical alternatives to burning. The demand for burning by nonindustrial private forestland owners cannot be met because of shrinking State agency funds for state conducted burns and shortage of insured burning contractors. Burning on public lands has been increasing; ecosystem assessments, national forest plans, and endangered species recovery efforts call for further increases.

The cost of prescribed burning has risen more than twofold since 1982—twice the rate of inflation and more rapidly than the costs of other silvicultural and wildfire hazard reduction practices. Some of this increase has been due to air quality regulations and the risks of liability for accidents, smoke intrusions, or escaped fires. States vary widely in their approaches to regulation and liability protection. So-called "certified burner" laws have been passed in five States to limit liability for qualified burners. KEYWORDS: certification, fire economics, fire management, liability, smoke management, prescribed burning.

INTRODUCTION  

Prescribed burning is a valuable land management and protection tool that has been well accepted as a professional forestry practice. In recent years, an average of 4.4 million acres per year has been prescribed burned across the South, roughly 7% of the forestland in the pine forest type. Proponents of prescribed burning call for increased burning to enhance fire-dependent ecosystems and commercial forests and to prevent future wildfires (Mutch 1994). However, as a source of air pollutants, traffic hazards, and escaped wildfires, prescribed burning is being increasingly scrutinized and regulated. Opponents want to lower smoke emissions from burns near communities and roadways and to minimize the risk of escaped fires.
Landowners use prescribed burning for a number of benefits: site preparation, vegetation control, fire hazard abatement, wildlife habitat improvement, and others. Costs are incurred in planning, conducting, or contracting each burn, and losses may occur due to tree mortality or injury if the fire becomes too hot or escapes the burn perimeter.

The demand for prescribed burning is derived from the demand for timber production, wildfire hazard abatement, wildlife habitat protection, and other products and services for which burning is an input. Factors influencing the use of prescribed burning include public opinion, the availability and costs of alternatives such as chemical and mechanical treatments, and public policies that discourage or encourage the use of fire. Demand is also affected by the attitudes of landowners and burners toward liability risks and the availability and cost of insurance that could offset some of these risks.

The supply of burning services is determined largely by the burners' marginal costs of burning. Improvements in technology, such as aerial ignition, can lower these costs and enhance the supply of burning services. Constrictions in supply can be caused by the limited availability of private consultants or State personnel to conduct burning and may be exacerbated during coincidental periods of high-fire danger or by weather conditions that limit burning. Regulation of the timing of burns or the way burns are conducted can affect the supply of burning services by increasing: (1) direct and indirect costs of conducting burns, (2) transaction costs of obtaining permits and making the required plans, and (3) opportunity costs of foregone income if burning is abandoned or if resources are diverted from burning to safety and smoke management. Landowner attempts to minimize or avoid liability risks can also increase costs through premium payments for insurance, salaries for standby burning crews, or avoiding burning in areas of high risk near residences and roads.

The American people as a whole derive benefits from burning, including reduction of future wildfires and smoke emissions, some forest insect and disease control, and enhanced wildlife habitats. The social costs of prescribed burning include human health hazards and visibility impairment resulting in highway accidents associated with smoke. Other costs occur when fire escapes from prescribed burns. Some of these costs are shifted back to the burner through: (a) regulations and permits, (b) liability claims for personal injury or property loss, (c) direct insurance costs, and (d) opportunity costs borne by landowners who restrict or abandon burning to avoid liability problems.

The objectives of this study were to: (1) describe trends in the acreage annually burned in the Southern States and in the per-acre costs, (2) review and compare air quality, forest protection, and liability provisions of State laws relevant to prescribed burning, (3) identify possible influences of regulation and legal precedents on burning costs and levels of activity, and (4) explore policy implications and/or options that could remove barriers to the future use of prescribed fire.

METHODS

In late 1994 and early 1995, we canvassed forest fire protection officials and private sector owners in the Southern States to collect information about smoke management guidelines, programs for issuing permits, liability issues, and businesses offering burning services.

We contacted State agencies for data on the number of acres burned by year, the ownership of the land, and the purpose and location (district or county) of the burns. Supplemental information was obtained by contacting individual companies, consulting firms, and prominent landowners. The USDA Forest Service, Southern Region, provided excellent records on burned acreage in national forests in the South. Because of great variation in the States’ records, collection standards, and processes, we were not able to uniformly
compare many burned acreage variables. We identified trends in States where reliable information over a period of time could be obtained. Information on legal and operational variables was collected through indepth interviews with State fire officials and private burners.

Cost data were collected from the database reported in past issues of Forest Farmer. Since 1952, Mississippi State University and other southern universities have biennially surveyed about 350 major forest products companies, private landowners, consulting firms, and public agencies to obtain estimates of the costs of various forest practices (Dubois et al. 1995, Belli et al. 1993; Dubois et al. 1991). Burning costs have been tabulated for the Piedmont and Coastal Plain regions, by primary purpose of the burn and by ignition method. The limited sample size did not allow State or ownership comparisons.

Information on State air quality regulations and forestry laws was obtained from State agencies and searches of statutes, codes, and reported court decisions in law libraries.

RESULTS--ECONOMIC TRENDS

Status of Burning

For the period 1985-94, an average of 4.4 million acres of forestland was prescribed burned annually in the South (Figure 1). Most burning is done in Alabama, about 1 million acres per year, followed by Florida (901,000 acres), Georgia (806,000 acres), and Louisiana (445,000 acres). These amounts include both acres underburned and acres burned for site preparation, including burning in combination with chemical and mechanical treatments. The Southwide estimate is higher than the estimate of 3 million acres provided by earlier studies (Sandberg et al. 1978, Peterson and Ward 1993). These earlier studies made single-year estimates (ours was a 10-year average) for the most recent period in which reliable data were available from all the Southern States. In some States, burning had increased since these surveys and had only recently experienced drops in acreage. Also, the earlier studies were done before some of the more sophisticated systems for issuing permits and collecting data had been initiated in some of the most active States. There is also the possibility that the types of burning being counted differed between the two surveys.

One indication of the intensity of burning activity in each State is the ratio of the acres annually burned to the acres in the pine forest type (loblolly/shortleaf and longleaf/slash) recorded in the most recent USDA Forest Service forest inventory reports (Figure 1). These ratios are relevant because most burning of forestland is done on pine sites. The ratios show that more than 13% of the pine forestland in Alabama is burned annually and almost 12% in Florida. Less than 10% is burned annually in the other States; Virginia and Oklahoma have the lowest intensities. The average Southwide ratio is 7%. These percentages are not equivalent to intervals at which fire (prescribed or wildfire) would return to the area, because the ratios include burning for site preparation as well as underburning and they do not distinguish one-time burns from recurring burns. Also, the ratios do not include the acres burned annually by wildfires.

About 89% of the acreage burned annually was on private and nonfederal public land. The USDA Forest Service burned about 500,000 acres per year, or about 11% of the total. The heaviest concentrations of burning on national forests were in the Carolinas, Mississippi, and Louisiana. The burned/pine type ratio for the Southern national forests was 13%. Nonindustrial private forests (NIPF) received proportionately the lightest prescribed burning. Even in the most heavily treated States, less than 2% of the NIPF pine acreage was burned annually. The NIPF ratio varied from 0.87% in Virginia to 1.8% in North Carolina.
ACRES BURNED ANNUALLY

Southwide: acres annually burned = 4.4 million; ave. burn/pine ratio = .072.

Figure 1.—Forestland acreage that was prescribed burned in the Southern States for all ownerships (annual average for 1985-94). Acreages include silvicultural burning for site preparation, hazard reduction, or wildlife enhancement. Acreages burned for cattle grazing or agriculture is not included. Source: State forestry agencies and USDA Forest Service forest inventory reports.
Data on acreage by purpose of burn, when available, was interesting. In Alabama, for example, 23,580 units were burned annually, 80% of which were site-preparation burns and 20% were underburns. Estimates of the primary purpose of these burns were made by county foresters as they processed notifications. Site-preparation burns were small, averaging 13 acres, while underburning units averaged 166 acres and accounted for 77% of the total acreage that was prescribed burned (Cobb 1995). Some of these so-called site-preparation burns could have been made for land clearing or nonforestry purposes; most were designated as scattered (as opposed to piled) debris burns. Most (70%) of the underburning was done for fuel reduction, and the next largest portion (20%) was for wildlife habitat. Wildlife habitat burns were the largest, averaging 442 acres, compared with 124 acres for fuel reduction burns and 154 acres for hardwood control.

Burned Acreage Trends

From 1985 through 1994, prescribed-burning trends varied across the Southern States. Arkansas, Florida, Mississippi, Texas; and eastern Oklahoma have seen reductions in the number of acres burned annually. The most dramatic decrease has been in Texas, from a peak of about 280,000 acres in 1986 to less than 90,000 acres in 1993 (Figure 2). Florida's burning program underwent substantial reductions in the 1980's but appears to have stabilized.

Alabama, Louisiana, South Carolina, and Virginia have had a more stable acres burned pattern; however, there is year-to-year variation due to weather and budgets. South Carolina's program was interrupted by Hurricane Hugo but has since rebounded. Georgia and North Carolina have shown increases in acres burned. State officials in Georgia caution that some of their reported increase may have come from many landowners who are reporting their burning activities for the first time under the new permit-issuing program.

Agency and industry contacts attribute decreases in burning to a combination of (1) increasing complaints by the public, (2) a number of expensive and well-publicized liability cases, (3) stiffer enforcement of air quality restrictions in poor quality air around designated non-attainment urban centers, (4) the growth of local government restrictions and regulations concerning permits, and (5) research and operational experience that has called into question some of the traditionally held benefits of burning.

It is difficult to infer definitive trends from these data. Each of the States follows somewhat different reporting systems and protocols. Some States report acres actually burned; others record acres for which burning permits have been issued. Some collect and tabulate information by county, primary purpose, and other parameters. Other trends that were mentioned by State agency officials were not captured in the data. One such trend is a shift to more spring and summer burning to expand the available burning period. Another is the increase in burning for wildlife habitat and ecosystem management purposes.

The intensity of fire use across ownership categories varied greatly. Relatively little of the NIPF pine acreage was burned. Low use of fire here may be attributed to generally passive attitudes about management and to fear of escaped fires. However, State agencies and consultants generally agreed that the demand for NIPF burning services is much higher than can be met because of shrinking agency budgets and a decreasing supply of commercially insured burning contractors. Smaller private owners depend on the State agencies or private consultants to manage the fires and assume any risks connected with them. However, many consultants and contractors have discontinued burning services because of the liability risk and the high cost of insurance. Without better availability of burning services, the struggle against fuel buildup and hardwood encroachment on NIPF pine sites may be prolonged.

In most States, the industrial sector has maintained its burning activity levels. However, many companies plan to burn fewer acres in the future. They cite regulations and liability risks, higher prices and better utilization standards for wood residues, chemical and mechanical alternatives to burning, and for some, a growing emphasis on less intensive silvicultural
Figure 2.--Acreage prescribed burned by year, east Texas, 1982-93.
Source: Texas Forest Service.
systems. One official mentioned that his company is cutting back on burning because of pine growth losses caused by burns becoming too hot. Another official mentioned concerns about possible disruptions in nutrient cycling caused by excessive removal of forest debris. As exemplified in Texas trends (Figure 2), decisions about burning by a small number of companies can strongly alter the overall burning pattern and can have distinctive impacts on the landscape. Industry cutbacks in burning have been more common near urban areas. These cutbacks are unfortunate from a fire protection standpoint because, unless treated, these areas offer the greatest potential for putting human values at risk from wildfires.

The number of acres burned on national forests has either held steady or increased in all States. Although Federal lands comprise only 6% of the pine forestland in the South, national forests alone accounted for about 11% of the prescribed burned acreage. Burning on national forestland accounted for 43% of the total burning in Mississippi, 32% in Texas, 23% in Arkansas, and 14% in Louisiana. Furthermore, ecosystem assessments, forest plans, endangered species recovery plans, and longleaf pine restoration plans call for two- to three-fold increases in underburning activity. Doubling the Federal acreage burned, assuming a stable private burning program, would increase the Southwide federal share to more than 20%. In light of deficit reduction efforts, negative public attitudes toward burning, limited burning periods, and liability risks, the likelihood of implementing these goals may be lower than envisioned by federal planners and burning advocates.

Cost Trends

The cost of prescribed burning in the South has increased faster than the rate of inflation (Figure 3) (Dubois et al. 1995). The average per-acre cost of burning in 1994 for all ownerships and regions was $10.57, a 257% increase since 1982. The average annual rate of price increase was 12.5%. The Producer Price Index increase for the 1982-1994 period was 122%. Most of the increase in burning costs ($5.73 out of the $6.45) has accrued since 1986. Cost increases show no signs of subsiding, judging by the $2.43 per acre increase between 1992 and 1994. Prior to 1982, burning costs increased at a slower rate, averaging about 8% annually.

Burning costs have increased faster than the costs of chemical and mechanical vegetation controls (Figures 4 and 5). This trend has not been obvious because of the relatively small per-acre cost of burning. Chemical removal of undesirable trees averaged $67.41 in 1994 while mechanical site preparation was $100.74 (Dubois et al. 1995). Chemical and mechanical treatment costs rose sharply in the 1970's, presumably in response to inflationary pressures on petroleum product prices, workers' compensation costs, and environmental concerns about chemicals and heavy equipment use. Since 1982, increases in these nonfire treatment costs have been low, 5.4% per year, with little change since 1986.

One implication of rising burn costs is the possible substitution of chemical or mechanical treatments on areas that are now being burned. However, comparisons of burning with other treatments can be deceiving because one cannot be perfectly substituted for the other. Fire is prescribed for a wider variety of objectives than are chemical or mechanical treatments. Prescribed fire is considered to have no alternatives in some forestry, wildlife habitat, and ecosystem management applications. This is especially true for regular underburning, which accounts for three times more acreage than site-preparation burning.

Conversely, burning cannot be considered a perfect substitute for modern chemical or mechanical methods in preparing a site for artificial reforestation. Several burns may be needed to meet the same goal that one chemical or mechanical treatment accomplishes and may expose the land manager to more public complaints and more complex liability risks. Large residual hardwoods cannot be controlled with prescribed fire. Prescribed fire might be considered a closer substitute for chemical or mechanical treatments in preparation for natural pine regeneration. More commonly, however, fire is considered a complementary part of the pine management regime and is used in combination with chemical and mechanical site-preparations treatments.
Figure 3.--Average Southwide costs of prescribed burning for public and private ownerships, 1967-94. Costs are weighted averages from surveys of all ownerships, regions, types of burns, and ignition methods. Source: Dubois et al. 1995.
Fig 4.--Cost per acre (nominal) of vegetation treatments, Southern U.S., 1967-1994.
Figure 5.--Relative per acre costs and trends for vegetation treatments, Southern U.S., 1967-1994. Costs are indexed, set to 100 for 1967. Source: Dubois et al. 1995.
The costs reported above are averaged and weighted by the acreage reported from responses for the Piedmont and Coastal Plain regions and for a variety of burning purposes and burning techniques. Burning is traditionally less expensive in the Coastal Plain where most of the burning is done. Survey respondents probably represent an above-average level of efficiency. The marginal costs of burning on small or difficult tracts and those with less efficient operations could be much higher than the averages reported.

Burning costs vary by purpose and ignition technique. Underburning to reduce the hazards of wildfire contributed about 75% of the acreage and is less expensive than site-preparation burning. Using aerial ignition for burns to reduce hazards was the most inexpensive combination of purpose and technique. Using ground drip torch ignition for hazard reduction burns cost about the same as aerial ignition as recently as 1988, but the 1994 survey showed that ground ignition had become the most expensive method at $12.50 per acre. The costs of windrow burning and burning in combination with chemicals for site preparation actually dropped during 1992-94. The cost of broadcast burning on chopped sites increased from about $6 per acre in 1988 to $12 per acre in 1994 (Dubois et al. 1995).

Burn managers interviewed indicated that managing smoke and liability risk been responsible for many cost increases because both involve additional crews, closer supervision, and foregoing some burning opportunities, as well as increasing the cost of liability insurance. However, it would be inaccurate to attribute burning cost increases entirely to these factors. General inflation in labor, equipment, and other costs has been responsible for perhaps half of the recent increases. Nevertheless, the increases above the inflation rate could be indicative of a growing conflict between the use of prescribed fires and the growing human presence in rural areas.

RESULTS -- LEGAL BASIS

The legal basis for regulating prescribed burning can be broken into three areas: (1) air quality law, (2) forest fire control law, and (3) extensions of general tort law to property damage and personal injury resulting from escaping fire or drifting smoke (Hauenstein and Siegel 1980). The latter category includes interpretations of tort law in the areas of fire trespass and public and private nuisance attributable to smoke.

Air Quality Regulation

Air quality regulation for forestry burning varies widely among the Southern States (Table 1). Prescribed burning is addressed in the open-burning sections of State air quality laws and associated administrative rules. Depending on the State, prescribed burning may be either exempt from open-burning rules or subject to many constraints. In most States, the air quality agencies have delegated the administration of these regulations to the State forestry agencies.

Air quality regulations take the form of permits and scheduling requirements, as well as smoke management and safety guidelines. Detailed guidelines have been developed by States in their implementation of the Clean Air Act and are described in detail elsewhere (Hauenstein 1980). These implementation plans outline emission limits and a strategy for achieving national ambient air quality standards. The programs that affect prescribed burning have been based primarily on the control of particulate matter (PM), the primary pollutant from prescribed fires. Current standards apply to PM less than 10 microns in diameter. The Environmental Protection Agency has been considering new standards based on PM less than 2.5 microns in diameter (Stoneman, in press). Such standards could put prescribed burning under tighter restrictions, especially near urban areas where PM 10 goals have not been attained.
<table>
<thead>
<tr>
<th>Voluntary guidelines and regulatory requirements</th>
<th>AL²</th>
<th>AR</th>
<th>FL²</th>
<th>GA²</th>
<th>LA</th>
<th>MS</th>
<th>NC</th>
<th>OK</th>
<th>SC</th>
<th>TN²</th>
<th>TX</th>
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<td>Adjacent landowner, occupant, or local fire department alerted</td>
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<td>V adj. own.</td>
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<td>Air quality and visibility screening</td>
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<td>Fire attended at all times</td>
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<td>NA</td>
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<td>NA</td>
<td>V</td>
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¹ M=mandatory, V=voluntary, NA=not addressed in air quality regulations or voluntary smoke management

² Alabama and Georgia publications concerning voluntary smoke management guidelines are brief and limited in scope. Florida and Tennessee do not have State-published voluntary smoke management guidelines. Florida guidelines are included in the appendix to State open-burning regulations. These States refer to "A Guide for Prescribed Fire in Southern Forests" (Wade and Lunsford 1989) or other references.

³ Required in 17 counties within 5 protection areas, about 7 million acres.

⁴ Required October 15 through May 15.

⁵ Texas air quality regulations do not authorize burning within corporate limits.

⁶ Nighttime burning prohibited.

⁷ For 13 counties with populations greater than 65,000.

⁸ Fires cannot be set within specified distances of roads, residences, business, etc.
Hauenstein and Siegel (1980) concluded that, while the basic air quality statutes allow for strict regulation, the Southern States have opted for voluntary compliance—enforcing the existing laws and regulations when a complaint is filed, but implementing air quality considerations only as voluntary smoke management guidelines. Open-burning practices addressed in air quality regulations may include prohibited areas near roads and inhabited areas (set-back requirements); restrictions on window burning, prohibition of heavy, oil-based, starter fluids; or generally prohibited activities that impair visibility or degrade air quality. Furthermore, forestry burning may be constrained if smoke from a fire creates a nuisance and is prohibited during air pollution emergencies.

In some Southern States, air quality regulations, while exempting forestry from many stipulations against open burning, establish misdemeanor charges with stiff monetary penalties for violations of the rules that do apply. Infractions, such as burning during air pollution emergencies or outside time-of-day restrictions, using prohibited starter fuels, or, more generally, creating a nuisance, could conceivably result in fines of up to several thousand dollars per day.

In most States, air quality laws allow additional local-level ordinances. Previous studies have alluded to a growing number of county and municipal regulations concerning slash disposal and burning (Martus 1992, Hauenstein 1980).

Forest Fire Protection Laws

General forest fire protection statutes address notification and permit requirements for open fires and precautions to reduce the risk of escaped fire. Under the fire control authority, landowners are required to either notify or get permission from local officials of the State forestry agency in all but two States, Arkansas and Virginia.

Most States have compiled smoke management and prescribed burning guidelines that address the "mandatory" provisions of the State air quality statutes. These guidelines also include safety precautions against smoke intrusion, common sense rules to minimize public complaints, and provisions from State fire prevention and control laws. Many of the smoke management guidelines are based on research conducted by the USDA Forest Service and have been transferred to landowners and burners through pamphlets handed out when permits are obtained.

Prescribed burning guidelines of the Southern States commonly contain provisions in the following four areas:

(1) Planning requirements affect the complexity of obtaining permits and the extent of planning and notification required. States vary greatly in their approaches here. Written fire prescriptions are recommended in most States’ smoke management guidelines, but they are not universally required to obtain permission to burn. Fire plans are required by some State laws that limit landowners’ liability for damages from prescribed burning. Adjacent landowners must be notified of the planned prescribed burn in North Carolina and Tennessee. Procedures for obtaining permits and providing notification allow State forestry officials to effectively manage prescribed burning on an areawide basis and to inform burners of rules and precautions concerning fire/weather conditions. Through this process, agency foresters are alerted to details of the burn: its location, duration, and whom to contact in an emergency.

Permit and notification requirements vary among the Southern States (Table 1). North Carolina requires permits in writing, with more limited burning periods stipulated in permits issued in 18 high-hazard counties. Arkansas and Virginia do not require formal permission; however, Virginia’s Department of Forestry requests notification. The remaining Southern States require oral notification or permits.
(2) Scheduling requirements determine the extent to which seasonal and/or daily burning periods, or "windows," are regulated or scheduled in conjunction with other burning in the airshed. Most States limit burning to daylight hours to minimize the chances of nighttime atmospheric inversions trapping smoke. Most States reserve the right to prohibit open burning during severe droughts, periods of high fire danger, and air pollution emergencies.

(3) Burn parameter guidelines address the fuel type burned, distance and direction to human improvements, and quality or quantity of smoke produced. Two common provisions include prohibitions against starting fires with smoke-producing agents or burning windrows that contain large amounts of soil. Many States require that adequate tools, machinery, and personnel be on hand to control the fire, and several require that the watch continue until the fire is extinguished. A few States require firelanes to be plowed around the area to be burned if natural firebreaks do not exist.

(4) Safety precautions are measures prescribed for monitoring smoke and fire in relation to areas of human activity and for warning the public of smoke hazards near roads, residences, and health care facilities. Traffic monitoring, warning signs, and flaggers are specified by some States.

Liability Issues and Policies

Prescribed burning exposes burners to at least three types of liability risks: (1) escaped fires, (2) smoke intrusions into nearby communities, and (3) smoke-related highway accidents. In each of these risks, occurrences are rare, but can result in catastrophic losses. The risk of highway accidents is the most compelling risk to Southern burners because it can involve multiple personal injuries, expensive lawsuits, and lasting public distrust. Between 1979 and 1988, at least 27 accidents in the South were allegedly attributed to smoke from prescribed fires. These accidents involved 27 fatalities, more than 50 serious injuries, and numerous minor injuries (Mobley 1990).

An action that causes injury and creates a liability can be classified as criminal, civil, or both (Eshee, in press). Actions resulting in criminal liability are defined differently in different Southern States. Accidents resulting from infractions of statutes or regulations are generally subject to misdemeanor charges. If willfulness, rather than carelessness, is determined, felony convictions can result in some States. Infractions most commonly identified in fire protection statutes and regulations include inadequate preparation for the burn, burning during droughts, failure to adequately clear an area around the burn or failure to obtain a permit. Some statutes simply state that prescribed burners may be criminally liable for allowing the fire to escape. In a number of States, the burner is also responsible for any suppression costs incurred in controlling an escaped fire.

Criminal negligence is not a prerequisite for civil liability. The general legal rule for civil liability is that the landowners or burners are not liable for damages from smoke or escaped fire unless they have been negligent in carrying out the burn (Siegel 1985). However, avoiding civil negligence requires a greater level of care to prevent injuries or damages than is necessary to avoid criminal negligence.

In legal proceedings, civil liability may either hinge on whether legally established rules were violated or be assigned strict liability directly because the activity was classed as ultrahazardous. Strict liability can prevail even without established negligence or violation of any particular rule. This strict liability determination is found in Arkansas, North Carolina, Oklahoma, Texas, and Virginia.

In Alabama, Georgia, Louisiana, and South Carolina, open burning and air quality statutes do not directly address civil liability; therefore, generally established tests for negligence would likely apply. Mississippi law restates the general negligence test by specifically assigning civil responsibility for wanton or careless negligence. In other Southern States, including Arkansas, Florida, North Carolina, Oklahoma, Texas, and Virginia, civil liability is assigned to forestry burners who violate air quality regulations, fire protection laws, or both.
In the past 5 years, five Southern States have enacted legislation to authorize and promote the continued use of prescribed burning of forestland by limiting civil liability. These laws statutorily define prescribed burning as a legal and socially beneficial activity. Under these laws, landowners are not liable for damages and injuries from fire or smoke, provided negligence is not proven. The first of these limited liability statutes was enacted in Florida in 1990, followed by Georgia (1992), Mississippi (1992), Louisiana (1993), and South Carolina (1994).

These laws establish three conditions that must be met before the burner can be afforded liability protection. One condition is the presence of at least one certified burner at all times until the burn is completed. Burner certification and training is handled by the State; certification requires State-sponsored training in smoke management and burn safety. In Georgia, the burn manager does not have to be certified, but must have burning experience. The second condition, in at least Florida, Mississippi, and South Carolina, is the development of a written fire prescription or plan. The third condition is adherence to the rules and notification and permit procedures established under other laws. Also called "certified burner" laws, these prescribed fire Acts are intended to provide a more favorable legal environment for forestry burning.

CONCLUSIONS

The legal framework for prescribed burning is becoming more complex in some Southern States, requiring or at least encouraging compliance with numerous air quality laws, fire protection laws, and regulations at the State and, in some cases, local levels. In other Southern States, burning of forestland is subject to relatively little formal regulation. In all States, the law of general liability, as codified in statutory law, case law, and administrative rules, is a source of complexity and uncertainty.

Because regulation has become the accepted method of influencing actions that have the potential to adversely affect the environment and because of the increasingly litigious nature of the American people, compliance with smoke management guidelines, even if they are considered voluntary, will be increasingly important in staving off negative public opinion and more stringent regulation.

In the last 15 years, the costs of prescribed burning have increased rapidly, and acreage burned annually has decreased, although not so drastically. There is still a relatively strong demand for burning in most States, despite the rising costs. The current burning activity levels will continue at least until burning becomes so expensive or so risky that large numbers of owners either switch to alternatives or just stop burning. Shifting to chemical vegetation management may be an alternative, but it is more applicable to site preparation than underburning. Chemical and/or mechanical treatments present their own human health and environmental risks.

Burning is being abandoned now on stands that present the most complex and highest risks of smoke or escaped fire. Without prescribed fire, these stands may eventually be subject to an even greater risk of wildfire, insect and disease problems, and hardwood encroachment. Understory accumulations may make these stands more expensive to mark for sale or to prepare for the next rotation. Many of these stands are located in higher population areas causing a greater need for reducing wildfire hazards. The pattern of dispersed human development in forested areas may exacerbate liability risks and increase public pressure against burning areas that are now being burned with few problems. There is a need for an analytical assessment of the influence of population dispersion on burning and on the comparative risks presented by different combinations of natural fuels and population densities in these emerging exurban areas. Based on such information, forest owners whose properties are strategically important in reducing overall wildfire hazards could be protected from liability risks through government burning assistance.
or supported through education programs that describe to neighbors the many benefits of prescribed burning. For areas in the path of population growth, burning could be encouraged by streamlining the process of obtaining permits or by relaxing overly restrictive burning standards.

Programs that allow permits to be traded (Hahn and Lester 1989) may be beneficial in some key areas that are becoming increasingly urban. In these programs, burners who can control smoke at lower marginal costs would be allowed to buy permits from higher cost operators, thus reducing the overall cost of compliance while achieving the benefits of burning. This kind of program would have to be preceded by public discussions about the fire hazard issues and the role of a long-term, prescribed-burning program. Perhaps with facilitated discussion and more complete information about burning costs, risks, and benefits, new residents might agree to accept some level of prescribed burning and to fireproof their own structures against wildfires.

Liability risk was the most commonly mentioned deterrent to further use of prescribed fire. At the present time, certified burner laws appear to be the best answer to reduce this risk. One benefit of these laws will be that commercial insurers may be more inclined to underwrite qualified burners. However, at this early stage, there is no evidence of the legal defensibility of these laws or data to reflect whether they have changed burning costs or practices. People concerned with forest production and environmental protection have worked together for passage of these laws, which recognize the ecological necessity and mutual benefits of maintaining a strong burning program. Other States will probably pass similar laws; the forestry communities in Alabama and Texas have considered similar measures. Courtroom challenges will reshape certain provisions of these laws. Some burners may consider the requirements for burn management certification to be too strict and abandon burning. Others will continue to conduct burns without being certified; which is still legal, but lack of certification may become a distinct disadvantage in the event of a liability claim.

Other policies could be based on the availability of certified burners. Because liability risk is rare but consequential, group insurance pools could be developed to make insurance available to qualified burners at reasonable rates. Aggregates of insured burners could also be organized to consolidate burning services and to reach landowners not now serviced by State agencies.

Differences in burning activity by forest ownership may be a signal of growing conflict in some airsheds. Private burners may begin to question large scale increases in burning on public lands, especially if the general levels of public complaint, accidents, or escapes increase. Attempts by individual burners to hold the escape and accident rates to zero will only further increase public and private costs of burning, a critical prospect as public agencies downsize and the number of professionals capable of planning and supervising safe burns decrease. Anticipating these trends, Federal agencies and private burners could organize prescribed-burning councils whose objectives would be to coordinate burning and smoke management activities, share burning services and insurance, and educate the public through presentations and demonstration projects.
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