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ABSTRACT: *Passage of the Clean Water Act (CWA) of 1972 prompted states to invest significant resources to develop programs to control nonpoint source (NPS) pollution from forestry and other activities. Forestry-related agencies and organizations have since developed silvicultural best management practice (BMP) guidelines to reduce NPS pollution, maintain stream integrity, and meet state water quality standards. To determine the effectiveness and implementation level of best management practices (BMP) on public and private forestland, states further developed and implemented their BMP compliance monitoring programs. This study documents the similarities and differences in efforts, methods, resources, and expenditures among BMP compliance monitoring programs across the 13 southern states. 29(1):48–52.*

Key Words: BMPs, compliance, expenditures, monitoring, silviculture, southern United States.

Water resources are integral to local, state, and national economies and to the quality of life of their inhabitants. Clean water not only affects the health of the general public, but also influences industry, recreation, and wildlife habitat. For this reason, much state and national legislation has focused on keeping state and national water resources intact. One such piece of legislation is the Clean Water Act (CWA) of 1972, which established laws to restore and maintain the physical, chemical, and biological integrity of the nation's water resources (Granskog et al. 2002). Section 319 of the CWA requires each state to adopt programs to address nonpoint source (NPS) pollution which emits from an area or many sources rather than a single, identifiable source (MacLellan 2002). Funding for adopting NPS pollution programs is also provided to all states by the federal government under Section 319.

Since passage of the CWA in 1972, governments in the 13 southern U.S. states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia) have invested significant temporal, monetary, and human resources into developing, implementing, assessing, and improving programs to control NPS pollution from forestry and other activities (Brown et al. 1993, Ellefson et al. 2001, Lickwar et al. 1990). Most often, the responsibility for these programs has fallen to forestry-related agencies and organizations, which, with the assistance of regulatory and environmental agencies, have developed sets of silvicultural best management practices (BMP) (Ellefson et al. 2001, Prud'homme and Greis 2002). Silvicultural BMPs were designed to reduce NPS pollution and maintain stream integrity, thereby meeting state water quality standards (Prud'homme and Greis 2002). To date, all 13 southern states have developed BMP guidelines catering to their specific silvicultural needs, goals, and missions (Lickwar et al. 1990, Prud'homme and Greis 2002, Kilgore et al. 2003, 2004).

To determine whether BMP guidelines are being applied as intended on public and private forestland, many state forestry-related agencies and organizations have developed unique BMP compliance monitoring programs (Ellefson et al. 2001, Phillips and Blinn 2004). Based on the results of a 1997 survey, the number of states with BMP compliance monitoring programs has risen steadily since the 1980s (Kilgore et al. 2004). In 1997, 24 of 33 eastern U.S. states (73%), including all 13 southern states in the 2002 survey,

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had developed compliance monitoring programs (Ellefson et al. 2001, Kilgore et al. 2004). The reasons for the steady increase in monitoring programs are the ready availability of funds provided by the federal government under Section 319, the development of voluntary forestry BMP compliance monitoring protocols by the Southern Group of State Foresters (SGSF), and the need to estimate the levels of BMP implementation, refine BMPs, or target educational and technical assistance programs (Ellefson et al. 2001, Prud'homme and Greis 2002).

Although 6 of the 13 southern states have recently modified their compliance monitoring programs to include the SGSF protocols, differences in efforts, methods, resources, and expenditures exist and beg further examination. Previous studies by Lickwar et al. (1990), Ellefson et al. (2001), Prud'homme and Greis (2002), Kilgore et al. (2003, 2004), and Phillips and Blinn (2004) have examined silvicultural NPS pollution programs; reasons, structure, and information dissemination from BMP compliance monitoring programs; implementation rates and effectiveness for BMPs in the South; approaches to BMP compliance monitoring; and presence and use of information from BMP compliance monitoring programs, respectively. None have documented the efforts, methods, resources, and expenditures for BMP compliance monitoring across the 13 southern states collectively.

Methods

In spring 2002, state agencies involved with BMP compliance monitoring programs within the 13 southern states were surveyed using a modified Dillman Tailored Design Method (Dillman 2000). Contacts were compiled through Internet searches of forest agency websites as well as personal inquiries. Contacts were given a choice of receiving the survey by e-mail or mail. Surveys, with a cover letter, were then distributed by the preferred method, and a reminder e-mail or postcard was sent 1 week after initial survey distribution. All 13 surveys were returned.

Survey participants were asked to provide details about their current BMP compliance program (including monitoring responsibility, frequency, area, site selection, site monitoring methods, site compliance scoring, noncompliance penalties, personnel resources, and funding resources), estimate annual expenses incurred in conducting monitoring activities, and identify program strengths and weaknesses.

To investigate possible relationships among responses for details of compliance programs, Pearson's Correlation Coefficient was calculated for a select group of questions. Pearson Correlation Coefficients range in value from -1 to $+1$ and use actual data to measure the strength of linear association between two variables (in this case, responses) (Norusis 2000). Positive values indicate corresponding increases between variables; negative values indicate corresponding decreases between variables.

Results

Compliance Monitoring Programs

Eleven states indicated that broad BMP compliance monitoring programs were in place. The remaining two states (Kentucky and North Carolina) had only partial or incomplete monitoring programs.

For 10 states, the state forest agency (e.g., forestry commission, department of forestry, division of forestry, forestry service) was solely responsible for compliance monitoring. One state (Mississippi) shares responsibility for compliance monitoring between the state forestry agency and a regulatory agency that investigates complaints of impaired water quality due to logging.

Compliance Monitoring Methods

Monitoring Frequency

States indicated that compliance monitoring occurred as frequently as every 6 months (one state) or annually, every 2 to 3, 3 to 4, or 4 to 5 years (two states each). Other states monitor compliance randomly or periodically, continuously after harvest, or as needed (one state each).

Monitoring Area

Eleven of 13 states monitored only a sample of harvested sites; none monitored all harvested sites. Eight states monitored from 0 to 10% of the harvested area, while three monitored from 11 to 80% of the total harvested area.

Site Selection

Nine states used a combination of methods to select sites (e.g., random and aerial detection or annual harvest and severance tax data). Two states used a single site selection method (e.g., complaint investigation or aerial detection).

Site Monitoring

The specific method used to monitor compliance and detect noncompliance on harvested sites was almost unanimous across the states surveyed. Ten states used on-site, ground surveys, while one used aerial surveys.

Site Scoring

Three states scored sites for BMP compliance using a pass/fail system; five states used total percent compliance. One state each used a combination of methods to rank sites (e.g., pass/fail and ranking or pass/fail and presence/absence of violations).

Noncompliance Penalties

Penalties administered for noncompliance by states surveyed included fines (two states), education (four states), fines and education (two states), fines and loss of permits/licenses or fines, education, and training (one state each). One state imposes no penalties.

Monitoring Personnel

Monitoring teams may be composed of individuals from single or multiple disciplines. Some states used trained BMP personnel only (six states) or trained foresters (three states), while others used water engineers, and/or hydrologists (one state each). In 10 states, special training was required for personnel to monitor compliance. Costs for personnel special training ranged from $100 to $5K per person, with a mean of $2K.

Five states had 0 to 10 monitoring personnel, while two, three, and one state had 11 to 20, 31 to 40, or 51 to 60 personnel, respectively. Eight states reported that their present number of personnel was sufficient to monitor compliance, while three felt that 1 to 20 additional personnel were necessary and would be helpful.

Monitoring Funding

States received funding for all costs associated with monitoring BMP compliance (including travel, fuel, labor, salaries, equipment, printed materials, aerial expenses, and miscellaneous expenses) from Section 319 or state funds earmarked specifically for compliance monitoring (three states each), or both (two states). Funding also came from state general revenue (i.e., not earmarked for a specific purpose) and state/federal grants or forestry commission general funds (one state each). One state did not receive special funding.

Funding amounts for BMP compliance monitoring ranged from less than $10K to $150K per year, per state. Seven states felt that funding was not sufficient to cover costs of properly monitoring compliance, and that additional funding in the amount of $31K to $950K was needed.

Monitoring Expenses

Two states each incurred expenses of $20K and $150K for monitoring BMP compliance, respectively. Monitoring expenses incurred by states ranged from were $20K to $151K, with a mean of $89K.

Correlations Among Responses

Correlations among responses for questions of harvested area, percent of harvested area checked, amount of funding, funding sufficiency, number of personnel, personnel sufficiency, and costs for compliance monitoring were investigated. Results showed that the number of personnel was significantly, positively correlated with percent of harvested area checked, personnel sufficiency, funding sufficiency, and funding amount (Table 1). Personnel sufficiency was significantly, positively correlated with percent of harvested area checked, personnel number, funding sufficiency, and amount of compliance funding (Table 1). Compliance funding was significantly, positively correlated with percent of harvest area checked, personnel number, and personnel sufficiency (Table 1). Finally, funding sufficiency was significantly, positively correlated with percent of harvested area checked, personnel number, and personnel sufficiency (Table 1). No other significant positive correlation was detected.

Table 1. Correlations among harvested area, personnel, funding, and expenses for silvicultural BMP compliance monitoring programs in the southern U.S. (2002).*

	Percent of harvested area checked	Nimber of personnel	Personnel sufficiency
Number of personnel	**0.933**[a]		
Personnel sufficiency	**0.844**[a]	**0.791**[a]	
Amount of funding	**0.739**[a]	**0.601**[b]	**0.589**[b]
Funding sufficiency	**0.759**[a]	**0.769**[a]	**0.791**[a]

* Numbers in table correspond to Pearson's Correlation Coefficients.
[a] Significant correlation among responses ($p < 0.01$).
[b] Significant correlation among responses ($p < 0.05$).

Discussion

Compliance Monitoring Programs

A 1997 survey of compliance monitoring programs across the South by Ellefson et al. (2001) and a 2000 survey by Prud'homme and Greis (2002) found that all 13 states had compliance monitoring programs in place. Our survey found that, while most states still had broad BMP compliance monitoring programs in place, some were in the process of establishing broad BMP compliance monitoring or monitored only specific forest practice guidelines or harvesting operations.

State governments have historically assigned responsibility for NPS pollution control programs and BMP guidelines to lead forestry agencies (Prud'homme and Greis 2002). Consistent with the earlier findings of Prud'homme and Greis (2002), all but one state in our survey assigned sole responsibility to the lead forestry agency. Indication of complete responsibility for monitoring BMP compliance, does not, however, suggest that partnerships between state forestry agencies and environmental, pollution control, or regulatory agencies do not exist. State forestry agencies often use the skills, talents, perspectives, and resources of other agencies (e.g., state and local governments, forestry businesses, university extension services and departments, federal agencies, conservation and environmental groups, and landowner organizations) in compliance monitoring efforts (Lickwar et al. 1990, NASF 1996, Ellefson et al. 2001). Soliciting cooperation from other agencies, in turn, not only promotes goodwill but also increases the chances for a more thorough, well-rounded monitoring team, and, ultimately, a more successful and effective monitoring program.

Compliance Monitoring Methods

Monitoring Frequency

The frequency with which states conduct BMP compliance monitoring varies greatly. Monitoring may occur as frequently as every 6 months or as infrequently as every 4 to 5 years. Additionally, monitoring can occur randomly, periodically, or continuously after harvest. In some instances, compliance monitoring is only conducted after complaints have been registered or questions have been raised about BMP effectiveness by environmental groups, regulatory agencies, state and local governments, and other interest groups. These actions could not only influence the frequency but also the thoroughness of compliance monitoring. Ultimately, insuring that monitoring is thoroughly, correctly, and consistently done is at least as important as the actual frequency of monitoring.

Monitoring Area

The amount of timber harvested and the percentage of harvested areas monitored for BMP compliance can have a considerable impact on the success of compliance monitoring programs. Ellefson et al. (2001) and Phillips and Blinn (2004) found that states employed a variety of site selection methods for compliance monitoring, and that one state monitored all harvested sites, while 12 states monitored

only a sample of harvested sites. Likewise, in our survey, all of the states that have monitoring programs monitor only a portion of total harvested sites. However, no states in our survey monitored all harvested area or sites, suggesting that either the acreage harvested increased or the acreage monitored decreased from 1997 to 2002.

Site Selection

Site selection for compliance monitoring can depend on a state's selected monitoring protocols, BMP guidelines, funding and personnel resources, or other factors. Ellefson et al. (2001) and Phillips and Blinn (2004) found that examples of site selection procedures across the eastern U.S. included submission of potential sites from consultants, county foresters, and private forest management specialists; random selection; aerial detection; and harvest notification. Our survey found that state site selection procedures included random selection, aerial detection, complaint investigation, timber harvest data, annual severance tax data, and USDA Forest Service information. Several states elaborated further on selection methods, indicating that all harvesting operations for which they are notified are inspected, that random BMP audits are conducted, and that tracts are randomly selected for inspection from county severance tax data.

Site Monitoring

Almost all of the states in our survey used ground surveys to monitor compliance on harvested sites. The widespread use of on-site, ground surveys is most likely due to more effective detection of noncompliance and greater cost-effectiveness than aerial surveys. Although not explicitly stated, Ellefson et al. (2001) likewise suggested that ground surveys were the most commonly used compliance monitoring method.

Site Scoring

When checking sites for compliance with BMP guidelines, states often use scores or ranks to determine compliance or noncompliance. Interestingly, most states used a single method for scoring compliance. This suggests that insuring compliance is best and most thoroughly accomplished through simple, easily calculated methods. Alternatively, states may draw on past successes or failures in their or other states to select compliance scoring methods.

Noncompliance Penalties

When violations and noncompliance with BMP guidelines occur, states can and do impose a variety of penalties on polluters; the severity of which may depend on the extent of the violation and/or previous violations. In most cases, the responsibility for investigating and punishing water quality violators falls under the jurisdiction of state Departments of Environmental Quality (or the equivalent) and the Environmental Protection Agency (Prud'homme and Greis 2002).

Monitoring Personnel

The skills and training of personnel responsible for monitoring BMP compliance varies from state to state and may, in fact, include several individuals from different disciplines. Ellefson et al. (2001) found that, across the nation, state forestry personnel routinely take the required field measurements. They also found that a diverse array of personnel such as forest practice inspectors, habitat biologists, environmental specialists, environmental engineers, timber harvesters, industrial foresters, county government officials, environmentalists, soil scientists, fisheries biologists, hydrologists, and water quality specialists may also be involved in BMP compliance monitoring. Although our survey did not find an overwhelming diversity of personnel, some variation did exist among the southern states. The variation in the state personnel used in both Ellefson et al. (2001) and our survey most likely, and most simply, corresponds to personnel available to the agency and their completed training. Additionally, funding availability, monitoring method used, and monitoring area size will dictate types and number of personnel that need to be hired.

Often, personnel used in BMP compliance monitoring must undergo special training courses to conduct on-site, ground surveys and field testing. In 1997, 11 states required special training to conduct monitoring (Ellefson et al. 2001). In 2002, our survey found a one-state reduction from the 1997 number. Providing or requiring special training for personnel by most state agencies shows the priority and concern given to compliance monitoring by agencies and heightens the chances that effective and thorough compliance monitoring will be conducted.

The costs of training and number of personnel needed for compliance monitoring varies from state to state. Our survey found that the number of personnel needed ranged from 0 to 60, with most states having 0 to 10 personnel. By comparison, Ellefson et al. (2001) found that states typically had 2 to 3 full-time employees, but could have anywhere from 40 to 153 compliance monitoring personnel. Many respondents felt that the number of personnel was sufficient for monitoring compliance. However, sufficient numbers of monitoring personnel may, in many cases, be related to the sufficiency of funding for both special training and salaries.

Monitoring Funding

States receive funding for all costs associated with monitoring BMP compliance from many different sources, most often from Section 319 funds, state general funds, or special taxes and fees (Ellefson et al. 2001). In 2002, sources of funding listed for states surveyed were Section 319 funds, state general funds, state/federal grants, and forestry commission general funds.

In most cases, funding for monitoring BMP compliance came from multiple sources within a state and the combination of sources was often unique to a state. Given that most states draw partial funds from general accounts not specifically earmarked for the purpose of compliance monitoring nor sufficient to cover all expenses, it is not really surprising that states find it necessary to draw funds from a combination of sources nor that that combination is unique. If one source cannot supply the full amount of necessary funding, states may be forced to creatively combine funds from any and all available sources until needs are met. Unfortunately, even with creative combination, states often

find themselves falling well short of their funding goals and needs.

Monitoring Expenses

Total investments for properly monitoring BMP compliance can be very costly. In fact, Ellefson et al. (2001) found that total investment expense estimates in 1997 were $940K, more than 2.5 times the $365K spent on compliance monitoring in 1996 (NASF 1996). Additionally, the range of compliance monitoring expenses was $20K to $750K per year, per state. In 2002, ranges for state estimated compliance monitoring expenses were $20K to $151K, with an average of $89K, well below the figures from Ellefson et al. (2001). However, our survey was conducted over a smaller number of states, a fact that could easily affect the figures we obtained. It is apparent from both studies that BMP compliance monitoring is not an inexpensive endeavor, and more funding is needed.

Correlations Among Responses

Results of our survey suggest that the percent of harvested area checked and sufficiency of personnel is positively and significantly correlated with the number of personnel, amount of compliance funding, and sufficiency of funding and may have an important effect on BMP compliance monitoring efforts. In other words, an increase in the number of personnel and amount and sufficiency of funding will be accompanied by a corresponding increase in the percent of harvested area checked and the sufficiency of personnel to perform compliance checks. This is a significant finding since many respondents cited insufficient personnel and funding as some of the primary hindrances to effective and successful BMP compliance monitoring efforts. One might further conclude that increased funding alone would increase both personnel numbers, and the amount of harvested area checked.

Program Deficiencies and Suggested Improvements

States were queried regarding deficiencies and suggested improvements to their current BMP compliance monitoring programs. Common throughout the comments provided were a lack of qualified staff or high turnover for staff, difficulties in selecting sites, and funding insufficiencies. Other program deficiencies specifically listed by states include lack of program priority at the state level, high frequency of unreported or overlooked harvests, and difficulties in obtaining landowner permission. These comments expanded on issues brought to light in responses to earlier survey questions.

Most improvements suggested by agency professionals dealt with increasing available resources, improving training and data collection, and hiring better qualified personnel. Specific suggestions for improvements include following other states' programs, ensuring that all harvests are reported, securing more or better personnel, initiating random BMP audits and innovative outreach programs, developing easier and quicker data collection and data transfer methods, and implementing statistical analyses. The variety of suggestions provided hints of the diverse issues related to monitoring BMP compliance. Each agency could probably benefit from any or all of the suggested improvements.

Conclusion

State agencies in most southern states are making a concerted effort to monitor BMP compliance. Although the specific monitoring methods used are similar among the states, the funding and personnel allocated for compliance monitoring programs differs greatly. Other overall differences in monitoring programs and resource allocation may be attributed to the size of area in need of coverage and the amount of forestry activity taking place. However, in most cases, regardless of the amount of funds allocated or the number of personnel made available, agency professionals expressed a need for more of both.

Despite funding and personnel insufficiencies, these agencies are continuing to help educate landowners, the general public, and others about the benefits of compliance with BMPs, the effectiveness of BMP monitoring for maintaining clean water, and the importance of continuing these monitoring programs. Future studies can investigate long-term results, benefits, and ecological and economic effectiveness of BMP compliance monitoring. Such studies can do much to establish good relationships among monitoring agencies, landowners, and state and local governments and draw the attention of local, state, and national governments.

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