

VOLUNTARY IMPLEMENTATION OF FORESTRY BEST MANAGEMENT PRACTICES FOR WATER QUALITY PROTECTION IN ARKANSAS

Results of the 2017-2018 BMP Implementation Survey



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Voluntary Implementation of Forestry Best Management Practices for Water Quality Protection in Arkansas

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Executive Summary

The Arkansas Forestry Commission (AFC) surveyed the implementation of voluntary forestry Best Management Practices (BMPs) on 237 sites totaling approximately 18,947 acres. These sites were randomly selected from a pool of 4,786 candidate sites representing silvicultural operations that occurred in the spring or early summer of 2017.

The BMP implementation rate on the sites monitored was 93 percent. In general, implementation was highest on public and forest industry sites and lowest on private non-industrial sites. Public tracts averaged 99 percent; industrial sites averaged 97 percent; corporate sites averaged 96 percent; and private individual or family forest landowners (called FFLO throughout the rest of the report) averaged 86 percent. Statistically, there was no difference between public, industry and corporate scores. However, the FFLO ownership class score was meaningfully different than the scores of the other three categories.

Implementation rate by four regions:

- Delta – 92 percent
- Ozark – 93 percent
- Ouachita – 95 percent
- Gulf Coastal Plain or Southwest – 93 percent

Implementation rate by BMP category:

- Harvesting – 96 percent
- Regeneration – 98 percent
- Roads – 92 percent
- Streamside Management Zones (SMZ) – 89 percent

Common deficiencies in BMP implementation noted during the survey were:

- Absence of an effective SMZ;
- Lack of water bars on skid trails, fire lanes, and inactive roads;
- Inadequate stabilization of stream crossings (road and skid trail); and
- Poor utilization of seeding and mulch to stabilize loose soil.

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Background and Objectives

The 1972 Clean Water Act required states to establish a program to encourage implementation of Best Management Practices (BMPs) to control non-point sources of pollution. In the state of Arkansas, the Agriculture Department's Arkansas Forestry Commission (AFC) is the lead agency responsible for the Forestry BMP Program.

The BMP Program relies on the voluntary implementation of BMPs based on the training and education of forest landowners, foresters, and loggers. When BMP guidelines were first developed in the early 1970s, initial education and training efforts were based on data obtained from soil loss monitoring, and from information gathered while investigating complaints related to silvicultural activity.

The reauthorization of the Clean Water Act in 1987 required states to develop methods for determining the effectiveness of their BMP guidelines. In 1996, Arkansas adopted the BMP implementation survey procedures developed by the Southern Group of State Foresters to address this requirement. Titled *Silviculture Best Management Practices Implementation Monitoring, a Framework for State Forestry Agencies*, this document provided a

framework for monitoring BMP implementation that is statistically sound, objective, technically feasible, and consistent with BMP program efforts in all 13 southern states.

Objectives of the implementation monitoring program include:

1. Measuring, documenting, and reporting the statewide extent of implementation of forestry BMPs.
2. Evaluating the general effectiveness of BMPs as applied operationally in the field.
3. Determining the need and direction of forest BMP education and outreach programs.

This report documents findings of the eighth BMP implementation survey, which was performed in the winter and spring of 2018.

The AFC completed and published its first implementation report in 1998, the second in 1999, the third in 2001, the fourth in 2004, the fifth in 2007, the sixth in 2008, and the seventh in 2011.



Survey Methods

The eighth survey was conducted according to the publication *Silviculture Best Management Practices Implementation Monitoring, a Framework for State Forestry Agencies*, adopted in 1996.

Site Selection

A pool of sites of recent forestry activity that could be evaluated for BMP implementation was identified using LandSatFact. LandSatFact is a computer program which compares Landsat satellite images to detect changes in forest cover. Changes in forest cover selected for the pool were at least 10 acres in size and changes that were less than one-year-old were preferred. Within each county's pool, Microsoft Excel's random number generator was used to assign a number to each tract. The numbers, and corresponding tracts, were then sorted in ascending order. The appropriate number of tracts for each county were then selected from each county's pool. The number of tracts selected for the survey in each county was weighted based on timber severance tax data. AFC personnel contacted the landowners to gain access and determine the suitability of the site for the survey (only silvicultural activities were considered suitable; conversions to non-forest were not suitable). Landowners were divided into five groups: federal, state, corporate, industry, and individual or family forest landowners (FFLO). Statistical analysis from previous surveys indicated that a sample size of 200 sites would yield results within a 95 percent confidence level. Of 4,786 sites initially identified (Figure 1), 237 tracts were surveyed for BMP implementation (Figure 2, p. 7).

Site Monitoring and Analysis

All site evaluations were completed by the BMP Program Coordinator.

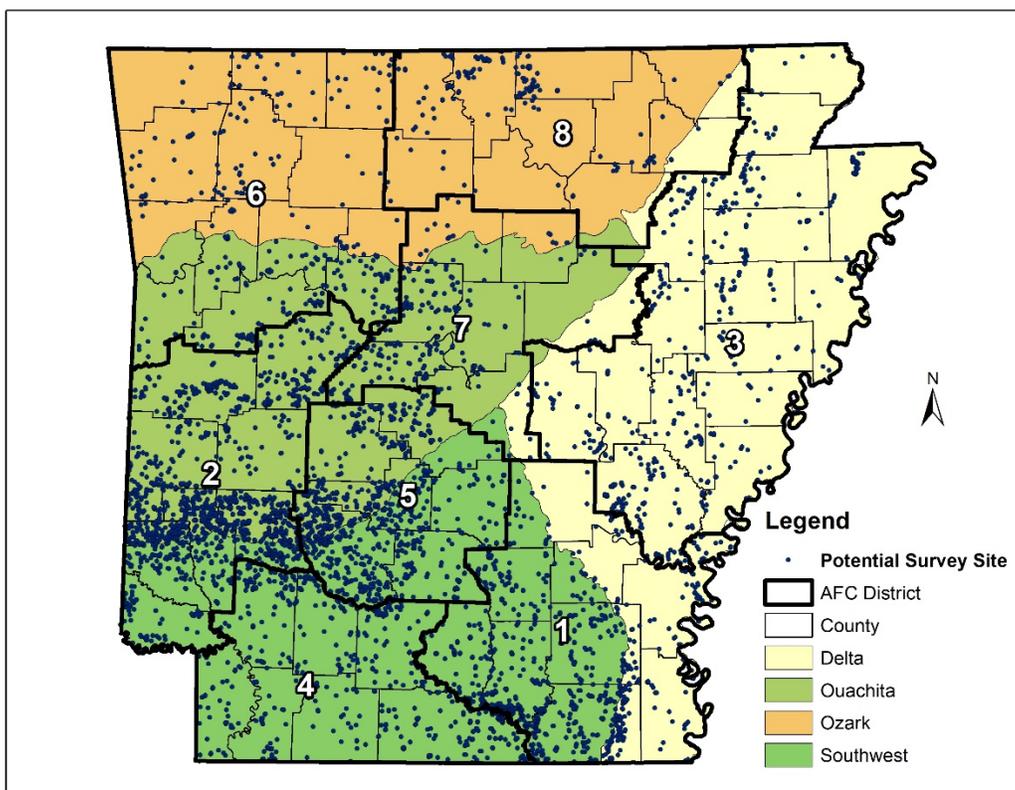


Figure 1: Distribution of candidate sites identified using satellite imagery.

The monitoring questionnaire used during the site evaluations was revised prior to the sixth BMP Implementation Survey to reflect state BMP guidelines adopted in March, 2002. The questionnaire consists of 67 questions based on four BMP categories: streamside management zones (SMZs), roads, harvesting, and regeneration.

Survey Methods

All questions were taken directly from the revised BMP book and referenced with applicable section and sub-section numbers as noted in the book. Each question was worded so that a positive answer was recorded with a “Yes,” while a departure from BMP recommendations received a “No” response.

Answers for questions that did not apply were indicated by “NA.” Each question also included a determination of significant risk. A significant risk is a situation or set of conditions that has resulted in, or very likely will result in, the significant and measurable degradation of water quality.

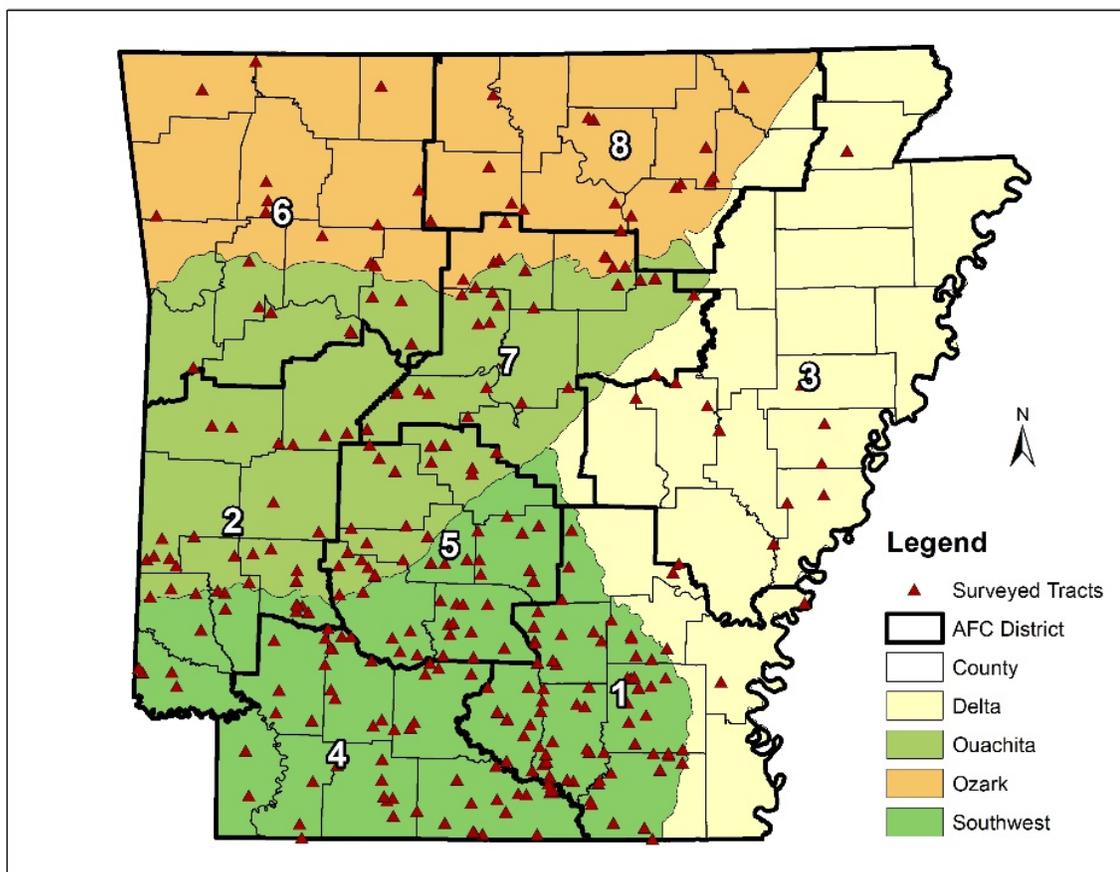


Figure 2: Distribution of harvest sites included in the survey.

Based on the results of the site evaluation, a final score was given to each tract. The score identifies the percentage of BMPs that are in place and effective compared to all the BMPs recommended for a particular site by the approved guidelines. Compiling data from all tracts allowed analysis of statewide BMP implementation. Analysis of BMP implementation based on BMP category, tract ownership, and state physiographic region was also conducted.

Besides the site examination, a separate survey was used to determine if differences in BMP implementation exist on sites owned by FFLOs based on the landowner’s familiarity of basic timber sale practices and recommendations.

BMP Survey Results

Overall BMP Implementation

The overall statewide rate of forestry BMP implementation was 93 percent (Table 1). Statewide, implementation of forestry BMPs related to harvesting and regeneration practices scored highest with rates of 96 and 98 percent, respectively (Figure 3). Implementation of forestry BMPs related to roads scored 92 percent, while SMZ BMP implementation scored 89 percent. Harvesting and regeneration BMP implementation were

meaningfully higher than road and SMZ implementation, and there was a significant difference between the road and SMZ categories.

These results follow the typical pattern observed in previous surveys. However, while the overall implementation rate has remained in the upper 80th percentile for the last three surveys, the statewide rate of 93 percent represents a statistically significant 3 percent increase from the previous survey.

Table 1: Overall BMP implementation summary

Category	Number of Tracts	Implementation Percent	Margin of Error
Streamside Management Zones	197	89	2.69
Roads	158	92	1.98
Harvesting	236	96	1.00
Regeneration	104	98	1.44
Overall Implementation Rate	237	93	1.32

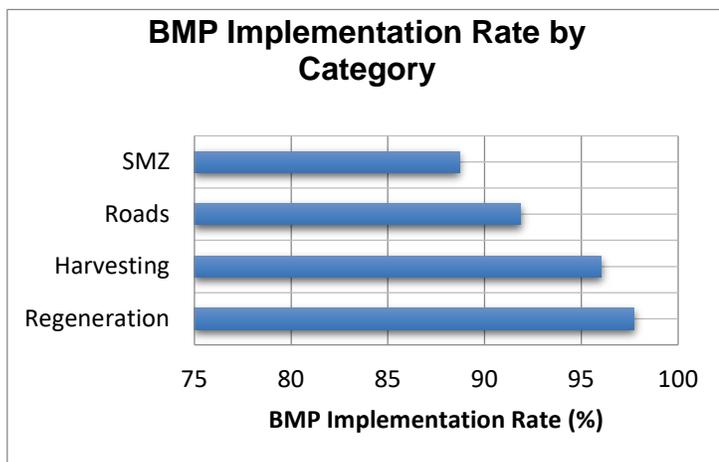


Figure 3: BMP implementation rate by BMP category

BMP Survey Results

Streamside Management Zones

SMZs are areas of forestland adjacent to non-perennial streams and lakes where forest management activities are limited to ensure water quality protection. While some harvesting within a SMZ is permissible, its primary function is to serve as a buffer between a stream channel and the more intensive forest management activities occurring outside the SMZ. Harvesting activities that do take place within the SMZ should be conducted in such a manner that minimizes the disturbance.

In this survey, the proper implementation of BMPs for SMZs was the lowest-scoring category in the state. Historically, SMZs have been the lowest-scoring category overall. Given the direct protection that SMZs provide for streams and prevalence of forestry activities where streams are present on site (SMZ protection was applicable on 83 percent of all sites monitored), it is important to identify deficiencies in SMZ implementation.

Table 2: Streamside Management Zone survey results

Streamside Management Zone BMPs	Number of Tracts	Implementation Percent	Sig. Risk
2.11. Minimum SMZ width (35') present for SMZs bordered by land with less than 7 percent slope?	181	92.27	-
2.12. Minimum SMZ width (50') present for SMZs bordered by land with slopes 7-20 percent?	33	96.97	-
2.12. Minimum SMZ width (80') present for SMZs bordered by land with slopes >20 percent?	3	100.00	-
2.14a. Basal area of residual trees in SMZ meet guidelines?	182	76.92	1
2.14b. Spacing of SMZ overstory trees meet guidelines?	185	85.95	-
2.16. SMZ trees removed in a manner that minimizes disturbance to the forest floor, exposure of mineral soil, or reduction of stream bank stability?	133	93.23	2
2.18. Absence of significant logging debris in stream channel?	162	82.72	7
2.19. Absence of toxic and hazardous materials such as fuels, lubricants, and solvents in SMZs?	195	100.00	-
2.23. Mechanical site preparation did not disrupt the ephemeral stream channel?	69	84.06	-
2.31. SMZ provided between braided stream channels as well as the prescribed SMZ width adjacent to the most exterior channels?	32	93.75	-
2.41. Appropriate SMZ provided for lakes and ponds?	53	86.79	-
2.51. Trees growing directly on the bank or overhanging a water body were not cut?	158	76.58	-
2.52. Mineral soil not exposed by prescribed fire?	25	100.00	1
2.53. SMZ is free of log decks?	195	100.00	-
2.55. Cave entrances and sinkholes free of logging debris?	2	100.00	-
6.12. Boundaries of all SMZs defined where site preparation occurred?	127	87.40	-
Streamside Management Zone Implementation Rate	198	88.70	11

BMP Survey Results

The state BMP recommendations for SMZs focus on two main areas: 1) they characterize the forest structure that should be retained during a harvest to ensure a properly functioning SMZ, and 2) they identify and discourage activities that could compromise one or more of the protective qualities of SMZ. Therefore, in the survey there are questions that address the appropriate width and structure of the SMZ (questions 2.11-2.14b, 2.31 & 2.41), and questions concerning poor practices occurring in the SMZ, such as the removal of bank trees or excessive woody debris being left in the stream channel (questions 2.16-2.23, 2.51-6.12). Field experience seems to indicate that those tracts with an appropriate SMZ in terms of width and structure typically have fewer problems concerning the poor practices occurring within the SMZ.



Of the 16 BMP questions on the survey concerning SMZs, nine were implemented over 90 percent of the time, while only 2 were implemented below 80% of the time (Table 2).

Significantly, the low scores for the SMZ category that deal with site preparation activities in the 2011 survey have been improved according to the current survey. Question 2.14a scored 68% in 2011 and 76% in the current survey. Likewise, question 2.23 scored 52% in 2011 and 84% in the current survey. Also, question 6.12 scored 67% in 2011 versus 87% currently.

The areas of greatest concern found in the current survey are:

- Failure to meet basal area target for residual trees;
- Spacing of overstory trees did not meet guidelines;
- Significant logging debris left in stream channel;
- Ephemeral stream channels disrupted by mechanical site preparation;
- Bank trees were removed;
- SMZ boundaries poorly defined before site preparation; and
- Appropriate SMZs were not provided for lakes and ponds

Where BMPs were not implemented correctly, there was likely no SMZ left, or one that was ineffective because of failure to meet width, basal area, or spacing guidelines. It follows that where the structural requirements for an SMZ are disregarded, there is also the likelihood that the effort will not be made to leave bank trees or to fell trees in a manner that minimizes the amount of woody debris being deposited in the stream. It should also be noted that of the 28 sites that had significant amounts of woody debris present in the stream channel, seven were substantial enough to be deemed a significant risk to water quality. Excessive woody debris can constrict the stream flow, leading to scour and possible flooding. Additionally, the breakdown of the woody debris can also lower dissolved oxygen levels, thereby impairing aquatic fauna.

BMP Survey Results

Roads

As indicated previously, approximately 92 percent of the BMPs for Roads were implemented properly on the 158 tracts where applicable.

There was a significant difference in the rate of implementation between road BMPs and SMZ BMPs, and both categories scored significantly lower than harvesting and regeneration BMPs.

The road network used in forestry operations has the greatest potential of negatively impacting water

quality if proper BMPs are not employed. This potential for impairment exists because the dirt or gravel roads commonly used to access timber serve as a constant source of sediment, which can be transported directly into a stream channel, most notably at stream crossings. To diminish the risk of impairment due to forest roads, the applicable BMPs focus on three broad areas: 1) proper planning, 2) practices to be followed during the harvest, and 3) close out procedures used to minimize the long-term effects on the road on water quality.

Table 3: Forest road survey results

Road BMPs	No. of Tracts	Implementation Percent	Sig. Risk
3.12. Roads located to avoid or minimize stream crossings?	154	100.00	--
3.13. Streams were crossed at right angles?	96	100.00	--
3.14. Where topography permitted, roads were located along the contour and along the crest of long ridges?	143	100.00	--
3.25. Side cast or fill material placed above the ordinary high water mark of any stream, except where necessary to stabilize stream crossings?	47	97.87	1
3.27. Seeding and mulching were employed in a timely manner to reduce erosion?	16	75.00	--
3.36a. Water turnouts, broad-based dips or rolling dips installed before a stream crossing to direct road runoff water into undisturbed areas of the SMZ?	91	86.81	--
3.36b. Roads, with the exception of stream crossings, located outside the SMZ?	122	100.00	--
3.42. Erodible areas, where natural vegetation is not sufficient to stabilize the soil, re-vegetated or stabilized?	24	58.30	--
3.48. Where needed, roadbed reshaped and all drainage systems opened when all forestry activities were completed?	121	66.94	--
3.52. On roads, temporary crossing structures removed and stream banks stabilized and restored after use?	16	81.25	--
3.53. Permanent stream crossings used bridges, culverts, shelf rock fords, geoweb, concrete slabs or other materials?	84	96.43	--
3.54. Low water ford banks are stable and stream bottoms are hard?	30	93.33	--
3.55. Except at stream crossings, equipment kept out of streambeds?	90	100.00	--
3.56. Are concrete slabs installed and functioning properly?	4	100.00	--
3.61. Broad-based dips present were needed?	128	97.66	--
12.10. Broad-based dips properly constructed?	124	98.39	--
3.71. Rolling dips present where needed?	67	97.01	--
12.20. Rolling dips properly constructed?	66	93.94	--
3.83. Wing ditches present where needed?	112	85.71	--
12.30. Wing ditches constructed and functioning properly?	95	96.84	--
3.85. Wing ditches not feeding directly into adjacent drainage, gullies, or channels?	97	96.91	--
3.90. Culverts present where needed?	95	90.53	--
3.92. Culverts installed properly?	86	93.02	--
12.40. Appropriate culvert size used?	85	100.00	--
3.97. Where needed, aggregate or other suitable material used on approaches to fords, bridges, and culvert crossings?	86	93.02	--
13.10. Water bars present as specified on inactive roads?	30	73.33	--
4.13. Water bars installed and functioning properly?	23	69.57	--
4.14. Sufficient distance left between outflow discharge of water bar and stream to allow "sediment fallout?"	42	88.10	--
Roads Implementation Rate	158	91.86	1

BMP Survey Results

In this category, the rate of implementation for 23 of the 28 questions scored at or above 80 percent. Of the remaining 5 questions, two scored in the 70th percentile, two scored in the 60th percentile, and one scored in the 50th percentile (Table 3).

Several questions showed significant improvement in the current survey from the 7th (conducted in 2011) survey. Question 3.25 scored 77.55 percent in 2011 and 97.87 percent in the current survey. Question 3.36a scored 67.95 52 percent in 2011 and 86.81 percent in the current survey. And question 3.90 scored 75 percent in 2011 versus 90 percent currently.

The areas of greatest concern are:

- Seeding and vegetative cover not employed in a timely manner to stabilize erodible soil;
- Water and sediment diversion structures not implemented or ineffective;
- Poor stream crossings; and
- Failure to follow all close out procedures upon completion of the harvest.

The BMP with the lowest score (58.30 percent) was the use of seeding and mulching to stabilize erodible soil. While the use of vegetative cover does depend on season and weather conditions, it is the least expensive and most effective BMP to stabilize soil and minimize erosion. Implementing vegetative cover when possible is strongly encouraged.

The other areas of concern were failure to properly install water bars when applicable and failure to re-shape the roadbed and open drainage systems following a harvest.

The failure to properly close out forest roads and the failure to install water bars as needed is likely due in large part to the cost and accessibility of the proper equipment and the lack of expertise required to implement these BMPs. Besides the cost associated with road work, and the lack of technical ability, there may also be a failure to recognize that these devices can be effectively designed without hindering future use and access.



BMP Survey Results

Harvesting

The process of skidding cut logs to a log landing, and the high-traffic volume on and around the landing itself, are two major sources of soil exposure that occur during a harvest operation. Understandably, a potential threat to water quality exists when these activities take place near a stream channel. BMPs developed to address the harvest operation, therefore, stress the importance of planning when deciding the location of log landings and skid trails. As with roads, the greatest potential threat to water quality during the harvest operation occurs at stream crossings on skid trails. Whenever possible, skid trail stream crossings should be avoided and the number of log landings minimized.

This survey indicates that overall, as in the past, logging contractors do a good job adhering to the BMP recommendations for harvesting; statewide, the implementation rate for harvesting BMPs was 96 percent (Table 4). For this category, nine of the 12

BMP recommendations were implemented more than 90 percent of the time. These BMPs deal primarily with the location of skid trails and log landings. One BMP - not using soil as a fill material at skid trail crossings - had implementation rates in the 80th percentile.

While most BMPs were followed, there are areas that need to be addressed. The primary area of concern is with the failure to properly stabilize skid trails following the harvest. Either temporary fill material was not removed from skid trail stream crossings or the stream banks were not adequately stabilized after the harvest 57 percent of the time. Likewise, water bars were not constructed on skid trails on 68 percent of the tracts evaluate. The failure to properly close out skid trails following the harvest led to two determinations of significant risks to water quality.

Table 4: Harvesting survey results

Harvesting BMPs	Number of Tracts	Implementation Percent	Sig. Risk
5.17. Are water bars constructed on skid trails per specifications in Table 13.1 & Figure 13.1, page 46?	74	67.57	--
4.23. Are the size and number of log landings minimized?	236	100.00	--
5.24. Are landings located away from SMZs on firm level ground?	230	99.13	--
5.25. Are landings located on dry sites so natural drainage disperses water onto the forest floor but not into a stream?	234	99.15	--
5.41. When skidding, were contours followed to the greatest extent possible?	180	100.00	--
5.43. Skid trails on slopes have occasional breaks in grade or logging slash that disperses water?	115	99.13	--
5.44. At skid trail stream crossings, soil not used as a temporary fill material when water was in the stream?	76	81.58	1
5.47. On skid trails temporary fill material removed from stream beds and stream banks stabilized?	74	56.76	--
5.48. No skid trails in stream channels?	202	98.02	1
5.52. Was skid trail construction minimized at grades greater than 30 percent?	29	100.00	--
5.53. On grades greater than 30 percent, were frequent rolling dips installed?	20	90.00	--
5.62. Litter, such as oil cans, grease containers, crankcase oil filters, old tires, and used fluids absent from the site?	235	99.57	--
Harvesting Implementation Rate	236	96.03	2

BMP Survey Results

Regeneration

Regeneration BMPs address potential threats to water quality that arise from intensive site preparation and reforestation activities. Where intensive management is recommended, typically a combination of prescribed fire, herbicide applications, mechanical site preparation, and reforestation practices are used to establish a new stand. Besides possible chemical contamination from herbicide applications, the use of heavy equipment and fire to prepare and reforest a tract can create a situation where sediment is introduced into a water body. Thus, the BMP recommendations for regeneration activities address the application of herbicides, proper fire management and fire lane construction, and the operation of heavy equipment.

The rate of BMP implementation for the Regeneration category was 97 percent. Thus, it appears that the majority of BMP recommendations are being properly implemented by site preparation contractors on a regular basis. Of the 11 BMP recommendations, ten had rates of implementation

greater than 90 percent (Table 5). The remaining BMP recommendation scored much lower and needs to be examined further. Where applicable, only 64 percent of the tracts had fire lanes that were constructed by hand within a SMZ. However, there were only 14 tracts in which this applied. While it is an uncommon practice to have fire lanes within a SMZ, soil disturbance within an SMZ should be minimized whenever possible. There was significant improvement between the 7th and 8th surveys on question 10.34 regarding installing BMPs in fire lines with slopes exceeding 5 percent at approaches to streams and roads. The score improved from 45.45 percent in the 7th survey to 97.15 percent in the current survey.



Table 5: Regeneration survey results

Regeneration BMPs	Number of Tracts	Implementation Percent	Sig. Risk
6.15. Has intensive site preparation been avoided on soils the NRCS has identified as highly erodible?	74	100.00	--
6.16. Existing water control devices (i.e. culverts, wing ditches) not damaged?	63	100.00	--
6.17. Heavy equipment operations avoided in wet soil conditions?	74	98.65	--
6.18. Did intensive site preparation follow the contours of the land?	71	100.00	--
7.11. Forest chemicals apparently excluded from SMZs?	48	97.92	--
8.11. Machine planting follows the contour of the land?	50	100.00	--
8.13. No evidence of machine planting equipment crossing or turning around in roads, road ditches, and wing ditches?	48	97.92	--
10.12a. Fire lines installed parallel to streams and not plowed through the SMZ?	40	97.50	--
10.12b. Fire lines within the SMZ constructed by hand?	14	64.29	--
10.13. On final harvest cuts, when slopes of the site exceed 20 percent, individual fire strips do not exceed 300 feet in width between ignition and burnout?	21	95.24	--
10.34. On slopes exceeding 5 percent, and at approaches to streams and roads, were water bars installed in fire lines according to the BMP recommendations for skid trails?	35	97.14	--
Regeneration Implementation Rate	104	97.73	--

Implementation by Physiographic Region

Besides determining the statewide BMP implementation rate, there was a desire to examine if BMP utilization varied within the state's different physiographic regions. While Arkansas can be divided into several regions, for the purpose of this survey the state was partitioned into four areas: Delta, Ouachita, Ozark, and Gulf Coastal Plain or Southwest (Figures 1 and 2). Seven tracts were in the Delta; 34 tracts and 37 tracts represented the Ouachita and Ozark regions, respectively (Figure 4). The majority, 159 tracts, were located in the Southwest region. While the Ouachita region had the highest level of BMP implementation (Figure 5), there was no meaningful difference between the BMP scores of any of the regions (Table 6).

The Delta region is actually a combination of two land forms, the Mississippi Alluvial Plain and the loess highlands known as Crowley's Ridge. Aside from Crowley's Ridge, the topography is generally flat, with numerous waterways. The dominate land use is agriculture, with forestry having little presence. There is some federal and state forestland ownership in the St. Francis National Forest, several national wildlife refuges and state wildlife management areas. Within the Delta region, SMZs had the lowest rate of BMPs (79 percent), while harvesting and regeneration BMPs had the highest score (100 percent) (Table 7). While the difference appears to be statistically different, caution should be used when interpreting these figures due to the number of tracts evaluated and the margin of error reported.

The Ouachita region is mountainous, though the terrain is not as steep or rugged as the Ozark Highlands. Pine is the predominant timber type and, as a result, there is a large forest industry presence. There is also a federal presence with the Ouachita National Forest. Of the tracts surveyed in the region, 56 percent were owned by forest industry while 12 percent were federally owned. Each BMP category scored over 90 percent.

Figure 4: Distribution of sites by region

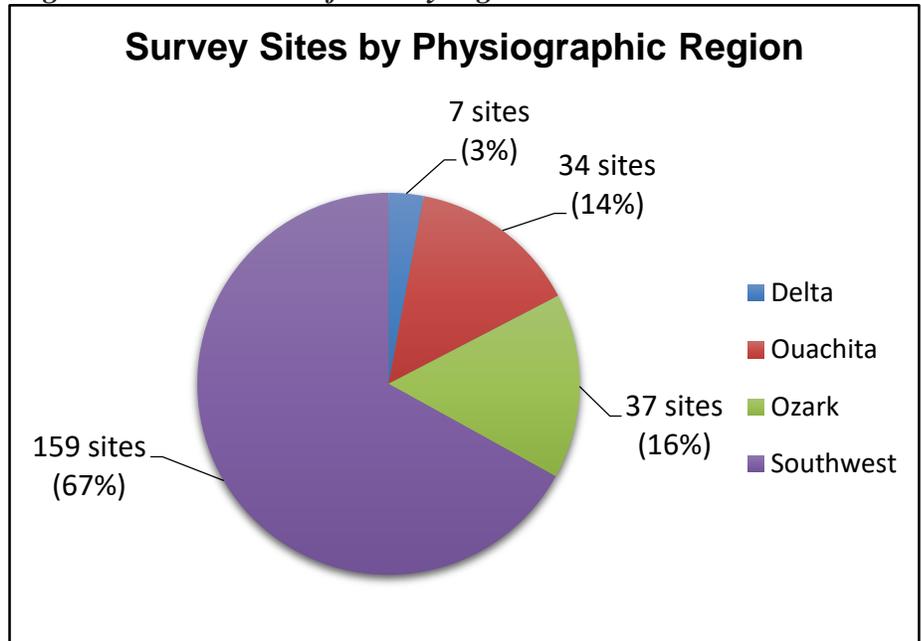
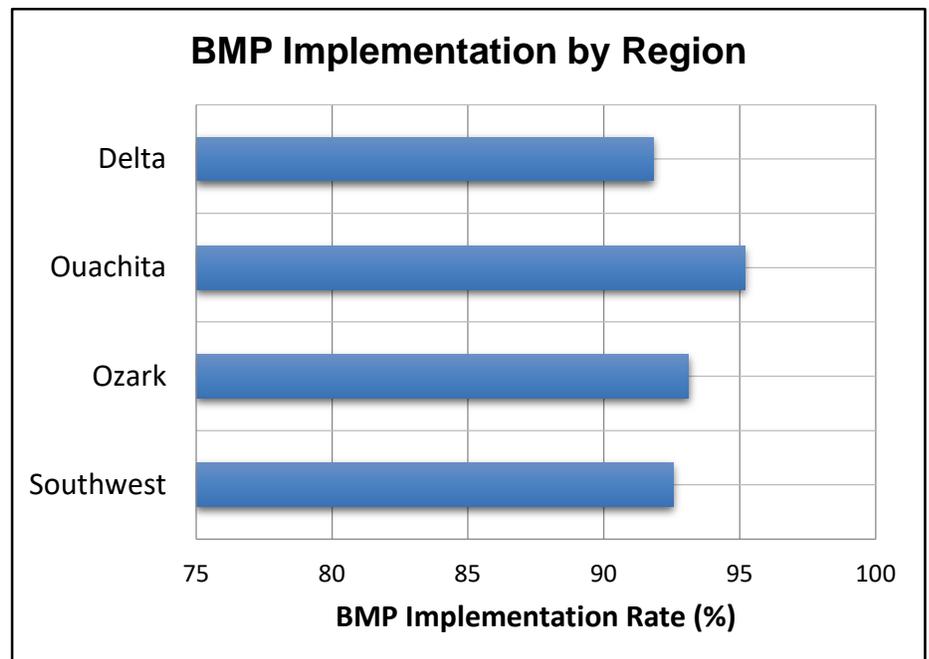


Figure 5: Implementation rate by region



Implementation by Physiographic Region

Regeneration was the highest score (98 percent) while the SMZ category scored the lowest (94 percent) although there were no meaningful differences between categories (Table 8).

The Ozark Highlands, found in the northern portion of the state, is characterized by its moderate-to-steep terrain, and an oak-hickory, upland hardwood, forest type. While heavily forested, the region is not a major timber producer. Fifty-nine percent of the tracts surveyed were privately owned. BMP implementation trends within the region were similar to the Ouachita region with the regeneration category having the highest score (98 percent) and the SMZ category having the lowest score (Table 9).

The dominate timber-producing region in the state is in the Southwest. Consequently, this is where a majority of the tracts examined in the survey (67 percent) were found. Because it is the most productive timber region, there is a sizable presence of forest industry and timberland investment groups. The plurality of tracts evaluated were industrially owned (38 percent), while 37 percent were privately owned, and 25 percent were corporately owned. Regeneration and harvesting categories both scored in in the mid to upper 90s (98 percent and 96 percent respectively). There was a meaningfully significant difference between regeneration, harvesting and the two lower scoring categories, SMZs (88 percent) and roads (91 percent) (Table 10).



Table 6: Implementation rate by physiographic region

Region	Number of Tracts	Acres	Implementation Percent	Margin of Error
Delta	7	528	91.81	6.91
Ouachita	34	2,699	95.19	3.11
Ozark	37	2,958	93.12	2.97
Southwest	158	12,462	92.55	1.70

Table 7: Delta Region

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error
SMZs	6	448	79.40	15.52
Roads	3	168	96.67	6.67
Harvesting	7	528	100.00	0.00
Regeneration	1	84	100.00	--

Table 8: Ouachita Region

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error
SMZs	30	2,557	93.76	6.24
Roads	29	2,515	94.20	3.22
Harvesting	34	2,699	97.75	1.77
Regeneration	18	1,990	97.91	3.27

Table 9: Ozark Region

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error
SMZs	29	2,697	90.34	5.79
Roads	28	2,047	92.51	5.26
Harvesting	36	3,058	94.48	2.84
Regeneration	14	1,485	97.62	4.76

Table 10: Southwest Region

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error
SMZs	133	10,513	87.62	3.45
Roads	97	8,804	90.73	2.65
Harvesting	158	12,462	95.81	1.28
Regeneration	70	5,867	97.64	1.74

Implementation by Ownership

Ownership was divided into four categories for the survey: public, industry, corporate, and Private Individual or Family Forestland Owners (FFLO). The 2011 survey was the first Arkansas survey that differentiated between corporate and industrial ownership. With the increased presence of non-traditional forestland owners purchasing lands formerly held by industry, the industrial category was split to allow for corporate ownership analysis. Industrial ownership was classified as those entities that owned forestland and had some kind of processing facility in the state. The corporate category included timber investment management organizations (TIMOs) and other similar entities. Of the 237 tracts evaluated for this survey, 88 (37 percent) were owned by FFLOs, 89 (38 percent) were owned by industry, 51 (22 percent) were corporately owned, and 9 (4 percent) were publicly owned (Figure 6). No meaningful difference was found in the scores of corporate, industry and public ownerships. However, a significant difference was found between the FFLO category and others.

Public

Public ownership consisted of tracts on the Ouachita and Ozark National Forests as well as the U. S. Fish and Wildlife Service. Nine tracts, comprising approximately 471 acres, were evaluated for BMP implementation, representing approximately 4 percent of all tracts surveyed (Figure 6). As in previous surveys, public land scored the highest for BMP implementation, followed by industry and corporate ownerships (Figure 7). However, there was no meaningful difference between public, industry and corporate ownership. However, a meaningful difference was found between FFLO (88 percent) and other ownerships.

Industry

Eighty-nine tracts (38 percent of all tracts surveyed) were classified as industrial ownership and consisted of 8,001 acres. Industrial ownership implemented BMPs at a rate of 97 percent. There was no significant difference between the industry, federal, and corporate ownership classes. Overall, implementation of BMPs for harvesting scored highest at 97 percent (Table 13). The implementation rate for road BMPs was the lowest score among the four BMP categories. While there was no significant difference between the harvesting and SMZ categories or harvesting and regeneration, there was a significant difference between SMZs and regeneration as well as a meaningful difference between roads and the other categories.

Figure 6: Distribution of sites by ownership class

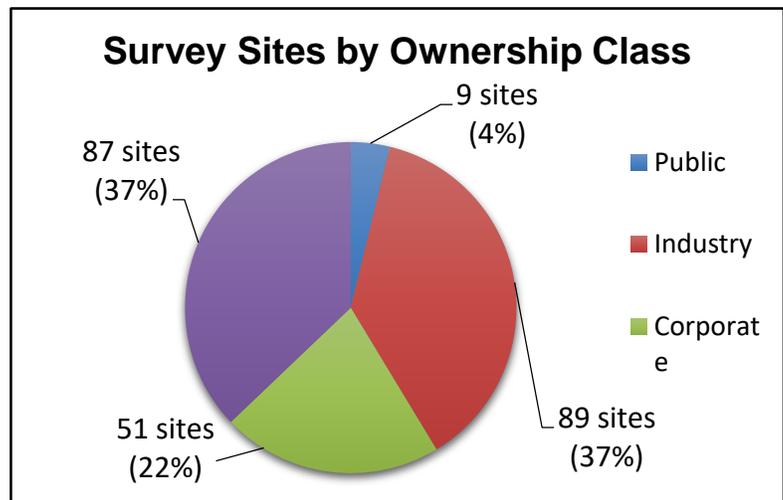
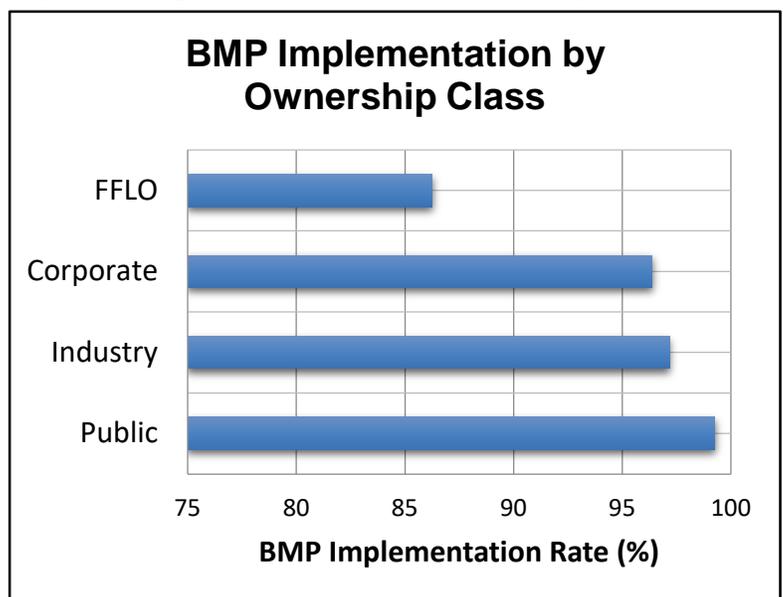


Figure 7: Implementation rate by ownership class



Implementation by Ownership

Corporate

Fifty-one tracts, comprising approximately 4,139 acres, were evaluated within the corporate ownership class. The BMP implementation rate for this ownership class was 96 percent. As for the implementation rates for the four BMP categories, regeneration scored highest with 99 percent, harvesting scored 98 percent, roads scored 95 percent, and SMZs scored 96 percent (Table 14).

FFLO

Eighty-eight tracts comprising 6,335 acres fell into the FFLO class. Comprising 37% of tracts surveyed, the BMP implementation rate for the class was 86 percent. This implementation score was meaningfully lower than the rate of BMP implementation witnessed on federal, industry, and corporate tracts. For BMP categories, the implementation rates within the FFLO ownership class were lower in every category when compared to the other ownership classes, with the exception of regeneration on public land in which there was only one tract surveyed. Harvesting and regeneration BMP implementation, as in the other classes, trended toward relatively high implementation rates for BMPs and lower rates for SMZs and forest roads. Although road BMPs only had an implementation rate of 86.7 percent, this was still significantly higher than the score of 76.59 percent for SMZs (Table 15).

Table 11: Implementation by Ownership Class

Ownership	Number of Tracts	Acres	Implementation Percent	Margin of Error
Public	9	471	99.25	1.00
Industry	89	8,001	97.17	1.06
Corporate	51	4,139	96.38	1.76
FFLO	88	6,335	86.25	2.67

Table 12: Public Implementation by BMP Category

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error
SMZs	7	396	100.00	0.00
Roads	8	297	99.26	1.47
Harvesting	8	371	100.00	0.00
Regeneration	1	100	66.67	--

Table 13: Industrial Implementation by BMP Category

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error
SMZs	66	6,522	96.84	2.57
Roads	61	6,411	93.42	2.81
Harvesting	89	8,001	98.26	1.04
Regeneration	45	4,810	100.00	0.00

Implementation by Ownership

Table 14: Corporate Implementation by BMP Category

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error
SMZs	46	3,646	96.10	2.85
Roads	39	3,287	94.51	3.31
Harvesting	51	4,139	98.28	1.42
Regeneration	25	2,163	99.00	2.00

Table 15: FFLO Implementation by BMP Category

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error
SMZs	79	5,651	76.59	5.10
Roads	50	3,738	86.70	4.17
Harvesting	88	6,335	92.11	2.08
Regeneration	33	2,552	94.62	3.58



FFLO Questionnaire

Historically, FFLOs have had the lowest BMP implementation rates. Given that FFLOs own approximately 46 percent of the forestland in the state, poor BMP implementation by this ownership increases the potential for impaired water quality due to forestry activity. Of the 16 significant risks to water quality that were identified in the survey, 13 occurred on nine FFLO tracts. Of those nine FFLO tracts, four had two significant risks each and five tracts had one significant risk each. The average BMP implementation rate for those nine tracts was 72 percent.

In an effort to improve FFLO BMP implementation rates, and to shape future educational efforts for private landowners, a previous survey started polling landowners to gauge their understanding of BMPs and basic timber sale practices. This FFLO questionnaire was included in this survey; the questions and results are below.

Question 1 – Was landowner familiar with AFC BMP Guidelines?

Of the 76 landowners who responded to this question, only 39 (51 percent) reported being familiar with AFC BMP Guidelines. This illustrates the lack of basic knowledge about BMPs and the need for education. It does appear that being familiar with the guidelines alone is enough to significantly improve BMP implementation rates; there was a significant difference in implementation rates between the two groups (Table 16).

Question 2 – Did the landowner require a written contract for the sale or activity?

The majority (92 percent) of landowners required a written contract for forestry operations. Having a sales contract, however, did not improve the likelihood of greater BMP implementation (Table 17).

Question 3 – If a written contract was required, were BMPs required?

Of the 70 landowners who required written contracts for forestry operations, 24 (34 percent) required BMPs to be implemented as part of the contract. The implementation rate was meaningfully higher for those tracts where BMP language was included in the contract (Table 18).



Question 4 - Was a registered forester involved in the sale or activity?

The majority of landowners (63 percent) indicated that a registered forester was involved in the sale or activity. The involvement of a professional forester did appear to improve the rate of BMP implementation (Table 19). This is different than the two previous surveys in which the involvement of a professional forester didn't seem to have a significant effect on BMP implementation.

Question 5 – Was the landowner a member of a professional forestry organization?

Only 36 percent of the landowners indicated that they were members of a professional forestry organization. Landowners who were members of forestry organizations had significantly higher BMP implementation rates than those who were not (Table 20).

FFLO Questionnaire

Question 6 – Was the logging contractor an Arkansas Pro Logger?
 The majority of landowners (83 percent) responded that an Arkansas Pro Logger was involved in the harvest. Arkansas Pro Loggers have had BMP training by AFC personnel; thus, there is the expectation that they would have a higher BMP score than contractors who have not had the training. There was a significant difference in BMP implementation between the two groups (Table 21).



Table 16: Question 1 – Was landowner familiar with AFC BMP Guidelines?

	Number	Acres	Implementation Percent	Margin of Error
Yes	39	3,016	93.11	2.87
No	37	2,437	78.98	3.59

Table 17: Question 2 – Did the landowner require a written contract for the sale or activity?

	Number	Acres	Implementation Percent	Margin of Error
Yes	70	5,208	86.23	2.96
No	6	245	86.24	8.36

Table 18: Question 3 – If written contract required, were BMPs required?

	Number	Acres	Implementation Percent	Margin of Error
Yes	24	2,275	95.27	2.60
No	46	2,933	80.67	3.58

Table 19: Question 4 – Was registered forester involved in the sale or activity?

	Number	Acres	Implementation Percent	Margin of Error
Yes	47	3,453	90.96	3.01
No	28	1,960	78.58	4.29

Table 20: Question 5 – Was the landowner a member of a professional forestry organization?

	Number	Acres	Implementation Percent	Margin of Error
Yes	27	1,791	97.56	1.43
No	49	3,662	79.99	3.03

Table 21: Question 6 – Was the logging contractor an Arkansas Pro Logger?

	Number	Acres	Implementation Percent	Margin of Error
Yes	62	4,283	87.52	3.17
No	13	1,111	80.13	5.18

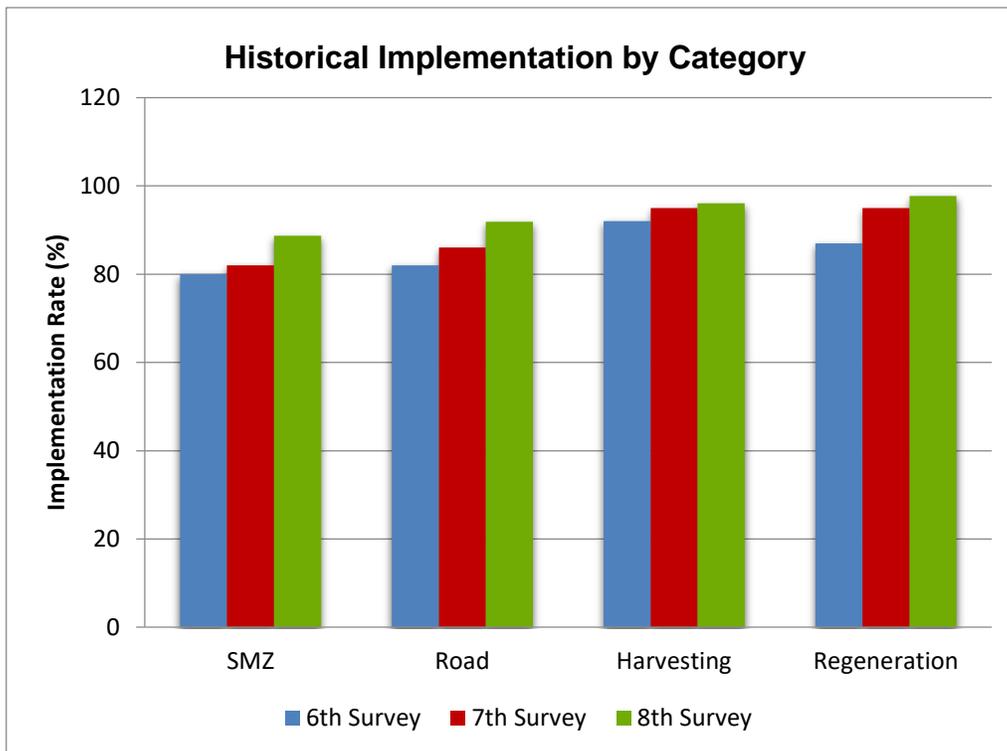
Historical vs. Current BMP Implementation

The implementation rate increased from 88.69 percent to 93 percent between the 7th survey and 8th, most current survey. The statewide rate of BMP utilization remained in the mid - to upper - 80th percentile from the fifth survey conducted in 2005-2006 to the 7th and last survey conducted in 2010 – 2011. The fifth survey is the earliest survey for which results are comparable.

A possible contributing factor to this increase in BMP implementation is the continuation and expansion of forest certification. A key requirement to obtain certified status is to follow state BMP recommendations. As certification continues to be a driving force in the industry, the expectation is that BMP implementation rates will maintain current levels or improve.

When looking at the trends for BMP categories over recent surveys, all categories are increasing. The biggest increase from the 7th to 8th survey was in the SMZ category (Figure 8). A possible explanation for this is that both corporate and FFLO ownerships for SMZ BMP implementation increased in the current survey over the 7th survey. Corporate ownership increased from 85.51 percent in the 7th survey to 96.10 percent while FFLO increased from 69.95 percent in the 7th survey to 76.59 percent in the current survey.

Figure 8: Implementation Rate by BMP Category for Recent Surveys



Conclusion

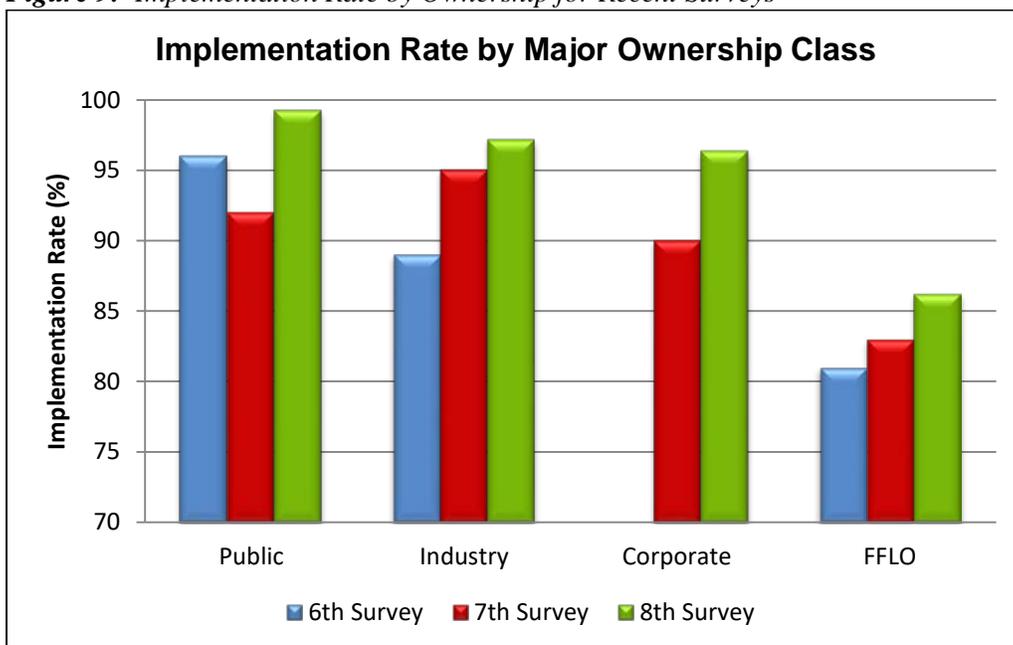
The use of BMPs is an effective means of reducing potential impairments to water quality that result from forestry practices. Tasked with the objective of decreasing the impact of forestry-related, non-point source pollution, the AFC BMP Program uses this periodic BMP Implementation Survey to identify trends in BMP use statewide. More importantly, the survey gives the AFC the ability to spot deficiencies in BMP implementation and address problem areas with targeted education and training.

The results of this survey indicate that, on average, 93 percent of all BMPs recommended by the Arkansas BMP guidelines are implemented on timber sales in the state. This rate of implementation represents an increase over previous surveys. In terms of the rate of implementation by BMP category, this survey reflects the same trends of previous surveys: BMPs for harvesting and regeneration activities had higher implementation rates than those for SMZs and roads, with SMZs having the lowest score. Likewise, the trends for ownership class were comparable with past surveys: public ownership had the highest rates of BMP implementation followed by industry, corporate and FFLO (Figure 9 and Table 22). As in the 7th survey, corporate class was separated from industry as an acknowledgement that changing ownership patterns may result in different management practices. However, there was not a significant difference in corporate and industrial ownerships.

Table 22: Implementation Rate by Ownership and Year

Survey Year	Public	Corporate	Industrial	FFLO
2017-2018	99 percent	96 percent	97 percent	86 percent
2010-2011	92 percent	90 percent	95 percent	83 percent
2007-2008	96 percent	--	89 percent	81 percent
2005-2006	96 percent	--	90 percent	81 percent
2002-2003	98 percent	--	93 percent	80 percent
2000-2001	89 percent	--	88 percent	74 percent
1998-1999	89 percent	--	87 percent	75 percent
1996-1997	94 percent	--	89 percent	81 percent

Figure 9: Implementation Rate by Ownership for Recent Surveys



Conclusion

This survey indicates, as did the 7th survey, that locality is not a significant factor in predicting BMP implementation. There were no significant differences in the BMP rates recorded in the four regions examined.

Besides the trends noted above, the survey also highlights some important deficiencies in BMP implementation. In the assessment of each BMP category, the specific BMP guidelines with the lowest scores were highlighted. Many, if not most, of these points of concern have been stressed in prior surveys, yet they remain problematic. There continues to be a significant number of streams that are not being adequately protected with an SMZ; when a buffer is left, its effectiveness is sometimes compromised by poor harvest practices within the SMZ. Where no SMZ is left at all, in some cases the error is due to the improper stream classification. Many contractors understand the need to buffer a constantly flowing stream, but erroneously identify non-ephemeral streams as ephemeral streams. Lastly, ephemeral drains are not receiving adequate protection during site preparation activities.

As was indicated in the last survey, many of the areas of concern in the remaining categories - roads, harvesting, and regeneration - could be improved by a placing a greater emphasis on BMPs used to close out a tract upon completion of the silvicultural practice. For example, common problems cited in these categories include failing to close out roads, skid trails and fire lanes with water bars, rolling dips or other sediment control devices.

Lastly, a primary goal should be improving the BMP implementation rate in the FFLO category. It appears from the FFLO Questionnaire, that the general level of knowledge of BMPs and their importance needs to be improved. As indicated in this survey, improving landowners' familiarity with BMPs alone appears to improve the rate of BMP implementation. There is also a significant difference in the implementation score if the landowner is a member of a professional forestry organization or requires BMPs in a written contract. There should be a multifaceted approach of improving landowners' general knowledge, while at the same time, continuing to encourage them to seek membership in a forestry organization that may offer assistance when conducting a timber sale.

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