Management and Economic Considerations for MIXED PINE-HARDWOOD STANDS

Dr. Shaun M. Tanger and Dr. Michael Blazier

Introduction

Growth in plantation forestry in the U.S. South has consisted almost entirely of softwood (*Pinus spp.*) over the last 70 years. By the early 1950s, there were roughly 2 million acres of pine plantations in the South containing 658 million cubic feet (approximately 20 million tons) of timber (USDA, 1988). As of the 2000s, there were 32 million acres of pine plantations in the South that contained 23.9 billion cubic feet (approximately 703 million tons) of timber (Wear and Greis, 2002). As of 2016, that number was closer to 41 million acres and 1.9 billion tons (Forest Inventory Analysis: Evalidator, 2016).

Over this same time period, significant increases in productivity have occurred. Annual growth per year of pine plantations has more than doubled, and rotation lengths have been cut by more than 50%. The success of pine plantation silviculture has turned the South into the wood basket of the United States (Schultz, 1997). Together this means a lot more trees and, therefore, a greater supply of raw materials for products that use softwood as an input. These products are dominated by housing or housing related products. In particular, 25% of all sawnwood goes to new housing, with the vast majority being softwood material.

For a time in the early 1990s to mid-2000s, because of the housing boom, timber prices for softwood stumpage were above $40 per ton. These days that figure is closer to $25 per ton. Given the success of pine silviculture mentioned above, experts believe that barring another housing boom those prices are unlikely to change in the next 10 to 15 years. Because of these depressed prices, many landowners are now asking, "Should I keep growing pine plantations?" Typically, in times of depressed prices, several things happen to timber stands. First, landowner willingness to pay for silvicultural and management costs drops. This reduction in management investments has two effects: (1) landowners are likely to get ingrowth from hardwood species (typically low-value ones like winged elm) and (2) the quality of their timber stands is diminished. Secondly, we see a drop in acres re-planted in pine. In light of these trends, forestry research and extension professionals in the South are striving to develop alternatives to intensively managed pine plantations for private nonindustrial forest landowners to maintain their land in forests.

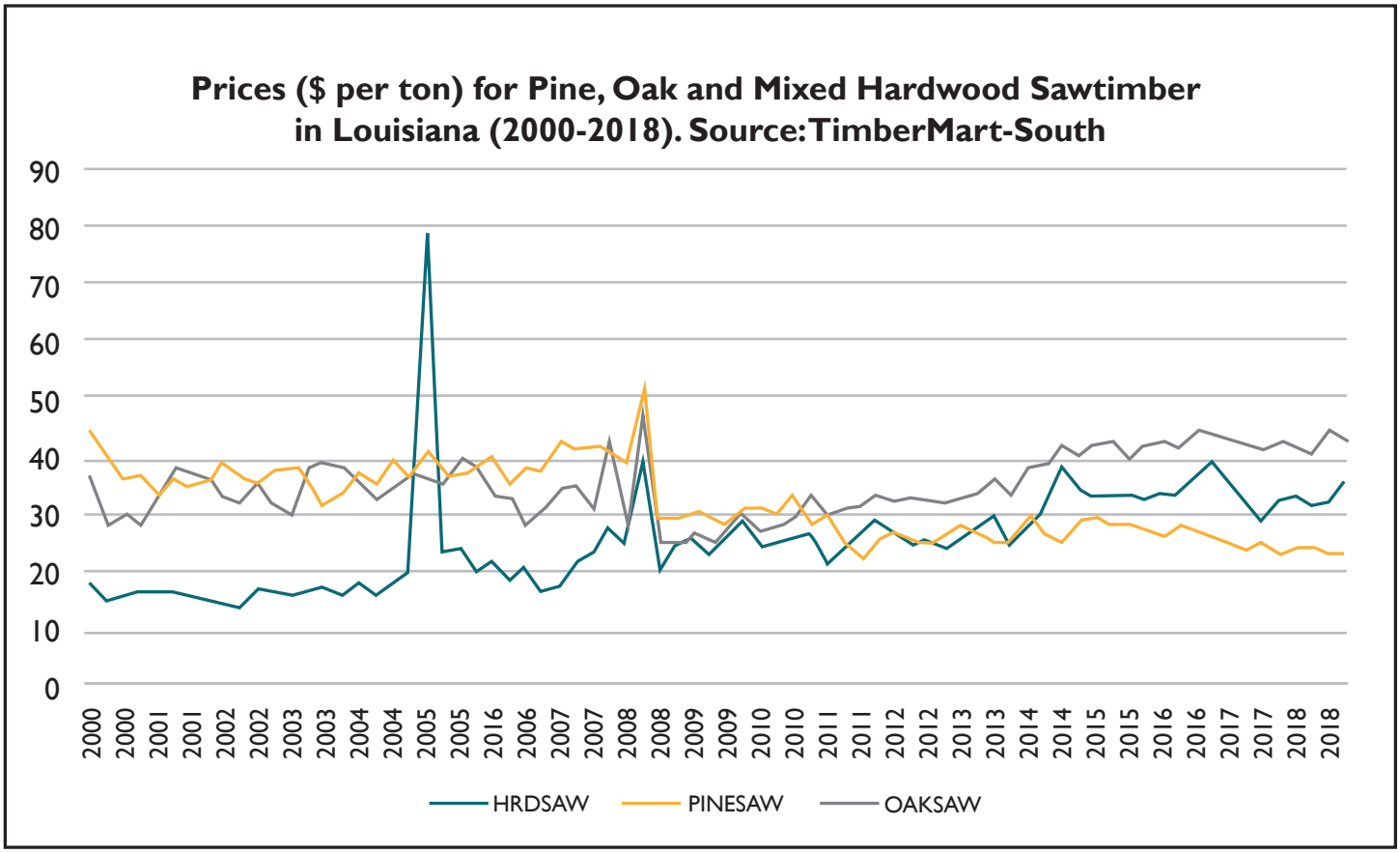
Alternatives to intensively managed pine plantations can be a variety of strategies that depend on the markets, both local and Southwide, and the landowners' objectives. One suggestion is to grow pine plantations with little to no management costs beyond what the cost-share programs will match. This approach has the advantage of keeping the spread of revenues and costs further apart but also sacrifices quality and perhaps forest health in the longer term. Another alternative has been to get to the final cut more quickly in the plantation. Spacing trees farther apart allows trees to put on diameter growth more quickly, which means the landowner can more quickly get to the product classes that are favored in their market. However, again this can jeopardize quality as self-pruning is reduced, which results in trees with defects. More importantly, the quick-growing trees have a higher percentage of juvenile wood compared to a tree that is the same size but was grown more slowly. This can harm the grading the timber can expect, which again could cause lower prices (see Softwood Lumber Grades and You, Mississippi State University Extension Service publication No. 2630). Lastly — and our focus for this publication — is mixing species, particularly pine, with a single hardwood while still maintaining the plantation approach.

Hardwoods tend to be more expensive in terms of reforestation (both seedling and planting costs), while their other establishment costs are similar to those of pine. Therefore, mixed stands tend to be more expensive to establish. Further, current research being done in the southeast has shown that there are volume sacrifices made when switching from a pine plantation to a mixed stand regime. However, these added costs are offset in a number of ways, both financially and biologically.

Reducing Financial Risks

If the last 30 years have taught us anything, it is that prices for pine fluctuate greatly. However, hardwood prices have been largely resilient. If you sold timber in the last 10 years, hardwoods typically yielded higher prices. See Table 1.

Table 1.



While it's hard to argue with managing for pine (over the last 30 to 40 years), the expectation is that hardwoods will carry a premium over pines in southeastern markets until the excess supply of pine is cut, and there is approximately 15 to 20 years of excess pine inventory in some markets.

Correlations between these two series are low as well. In fact, for pine and hardwoods they have been negative. This means these prices do not appear to move together, which provides a source of risk-hedging if the landowner is involved in growing both species. This insulates the landowner with respect to price variation and timing thinning or final harvest in comparison to a single species stand. See Table 2.

Table 2. Correlations Between Hardwood Sawtimber, Pine Sawtimber and Oak Sawtimber Prices.

	HRDSAW	*PINESAW*	*OAKSAW*
HRDSAW	1		
PINESAW	-0.30394	1	
OAKSAW	0.454195	-0.15898	1

Reducing Biological Risks Within a Single Stand

As we'll discuss in more detail in the section on management, hardwoods and softwoods do not compete with each other in the same way two trees of the same species compete with one another. Their root systems are different, their nutrient needs are unique and their growth patterns may be staggered — some may be shade-tolerant, while others are not. More importantly, mixed stands appear to suffer far less tree (and volume) loss when a mortality event, such as a beetle outbreak, occurs. In a recently published paper, the authors found that the volume losses in the mixed plantations were lower than either monoculture (10% to 16% for mixed plantations and 20% for both pine and sweetgum monocultures).

Having mixed stands allows for diversity to reduce individual tree stress that invites mortality.

Figure 1. Pine-sweetgum mixed plantation, Hill Farm Station, Louisiana State University (Homer, Louisiana).

Figure 2. Pine-cherrybark mixed plantation, Hill Farm Station, Louisiana State University (Homer, Louisiana).

Management of Mixed Hardwood Softwood Plantations

Managing mixed stands depends on providing the species planted with enough growing space to sustain their growth. The onset of tree-to-tree competition for light, water and nutrients is affected by the species selected as well as the density and configuration at which the trees are planted. When considering species to interplant with southern pines, hardwoods with fast height growth and low tolerance of shade (similar to that of pine), such as sweetgum, will reduce overall stand growth because of tree competition more than species such as Southern red oak (*Quercus falcat*a) and white oak (*Quercus alba*), which have greater shade tolerance and grow their roots within a slightly deeper zone of the soil than pine. Soil type is another important consideration in species selection; species vary in the soil textures and topographic conditions that best facilitate their growth. Tools such as the Web Soil Survey of the USDA Natural Resource Conservation Service are helpful in matching species to soil type.

Planting density and configuration have long-term effects on the growth and development of mixed stands. For landowners with forest product harvesting as an objective, market opportunities near their forests is an important consideration in planting density and configuration. If the only hardwood markets are for larger-diameter products, such as sawtimber, a relatively low density of hardwoods (100 to 200 trees per acre interplanted with 200 to 400 pines per acre) is preferred within the mixed stand so that only trees to be harvested for sawtimber are planted. If the only hardwood markets are for small-diameter products, such as pulpwood, a higher number of hardwoods (300 to 400 trees per acre) should be planted within the mixed stand. Similar considerations are necessary for the pines. An overall planting density of 700 trees per acre or less is likely to promote stand growth into merchantable sizes for pulpwood by ages 10 to 15 years with minimal tree-to-tree competition for site resources.

Planting configuration of the species can be tailored by altering the rows planted in each species, such as planting sweetgum every other row between rows of pine. Configurations can also be manipulated by altering the number of trees planted of each species within a row, such as spacing pines 10 feet apart within rows and spacing oaks

8 feet apart within rows. Clear communication with planting contractors and close oversight of planting is necessary for planting multiple species for mixed stand establishment.

In addition to the increased complexity of planting density and configuration considerations for establishing mixed stands, extra care must be taken for competition control measures. There are fewer herbicide options for pre- and post-planting for mixed stands because of hardwood vulnerability to herbicides commonly used for southern pine establishment, such as herbicides with imazapyr and metsulfuron methyl as active ingredients. Generally, relatively high rates (5 to 10 quarts per acre) of glyphosate-containing herbicides prior to planting pre-plant followed by post-planting applications of a sulfometuron methyl-containing herbicide is an effective herbicide combination for mixed stand establishment. However, some hardwood species are sensitive to sulfometuron methyl; the herbicide label must be consulted prior to its inclusion in mixed stand establishment competition control. For more on herbicide options for mixed stands, see Self and Willis (2019) in the references in the list below.

Other Benefits

Further, the stands allow for a greater diversity of other plant and animal life as more resources are available to a wider range or organisms. This is true for game and nongame species. For those landowners interested in game management and leasing hunting opportunities for revenue production, this mixture could lead to more game harvest opportunities and thus higher-valued leases. Mast-producing species, such as oaks, are particularly valuable for game wildlife. Fortunately, these are often the higher-valued hardwoods and tend to complement the pine well in terms of resource use within the stand.

Conclusions

Growing mixed-stand plantations can be a rewarding and lucrative practice for private landowners in areas with hardwood and softwood mills. Hardwoods are cost-shared similar to pine, so increased establishment costs will be somewhat offset by those savings. The biological and financial risk hedging that mixed stand management allows makes it an attractive alternative to pine-only plantations. This will be especially true for landowners who value other benefits beyond pure timber production, such as hunting opportunities, and landowners that are risk-averse in their investment behavior.

References

Jones, D., Seale, D. and Shusky, R. 2012. Softwood Lumber Grades and You. Mississippi State University Extension Service. Publication 2630.

Self, A.B. and Willis, J. 2019. Herbicide Options for Mixed Pine-Hardwood Management. Mississippi State University Extension Service. Publication 3264.

Schultz, R.P. 1997. Loblolly pine. The ecology and culture of lobolly pine (Pinus taeda L.). Agric. Handb. 713. Washington, DC: U.S. Department of Agriculture, Forest Service. [Number of pages unknown].

U.S. Department of Agriculture. 1988. The South's fourth forest: alternatives for the future. For. Resour. Rep. 24. Washington, DC. 512 p.

USDA Forest Service, Forest Inventory and Analysis Program, Wed Aug 07 18:25:01 GMT 2019. Forest Inventory EVALIDator web-application Version 1.8.0.00. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: http://apps.fs.usda.gov/Evalidator/evalidator.jsp]

Wear, David N.; Gries, John G., eds. 2002. Southern forest resource assessment. Gen. Tech. Rep. SRS–53. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 635 p.

Willis, J.L., Gordon, J.S., Tanger, S., Blazier, M.A., Self, A.B., Brodbeck, A. 2019. Managing Mixed Stands: Reassessing a Forgotten Stand Type in the Southeastern United States. Forests. 10(9):751. doi: 10.3390/f10090751.

William B. Richardson, LSU Vice President for Agriculture
Louisiana State University Agricultural Center
Louisiana Agricultural Experiment Station
Louisiana Cooperative Extension Service
LSU College of Agriculture

Pub. 3700 (online) 9/19