Site Preparation:
The First Step to Regeneration

People have been clearing land for agricultural purposes for centuries. They recognized early that weeds, brush, and stones had to be removed if crops were to grow well. This concept also applies to growing trees.

Site preparation is a necessary step in reforestation or afforestation (planting retired agricultural fields). Site preparation involves manipulating site conditions to increase the survival and growth of seedlings as well as to enhance the efficiency of tree planting or seeding. This is done by removing logging debris to make planting easier and reduce the hazard of wildfire. In addition, site preparation with disking eliminates unwanted vegetation that could compete with tree seedlings for sunlight, water, and nutrients. Disking can also restore a site after rutting and compaction from logging or heavy land-clearing. On wet sites, additional plowing to form planting beds will improve initial drainage for planted seedlings.

There are four primary techniques for site preparation: fire, mechanical, chemical, or some combination of these three. The objective is to do as much as necessary but no more. The average costs cited in the following sections for site preparation operations were taken from the published survey by Maggard and Barlow (2017).

Prescribed Fire

Native American cultures developed agriculture and used fire extensively. Fire as a tool was used in clearing land for farming and keeping hunting grounds open. Pre-Columbian civilizations created a mosaic of towns, agricultural fields, and extensive woodland-savannas in Mississippi. Thus, the native vegetation was adapted to very frequent burning, fostering the regeneration of fire-tolerant species and the exclusion of others. With frequent burning, southern pines dominated the forest landscape, especially longleaf pine, which is the most fire-tolerant of the southern pine species.

Presently, forestry research shows that trees grow best on sufficiently prepared sites free of vegetative competition. Controlling competing vegetation is especially important because trees need space, light, moisture, and nutrients in order to grow. An early forestry textbook described how mulching around trees reduced competing weeds and manual weeding benefited seedling establishment and growth.

Site preparation efforts should concentrate on slash disposal from logging debris. Slash has beneficial purposes (soil stabilization and nutrient retention), but too much prevents adequate natural regeneration and makes planting difficult. Consequently, slash should be removed to improve seedbed conditions by exposing mineral soil, thereby improving the environment for regeneration. The most common and inexpensive method for slash removal is prescribed burning.

When using prescribed fire for site preparation, burning conditions are usually optimal in late summer to early fall (**Figure 1**). At this time, the fuel is drier and the ambient temperature is higher. This leads to a more complete burn of the logging debris to expose mineral soil, which is so important for seed germination or tree planting. Site preparation burning averages $24 per acre in the Coastal Plains.

Figure 1. Setting a site preparation burn using a drip torch. Fire removes residual slash and debris from the seedbed.

Advantages	Disadvantages
Less soil disturbance	Produces smoke, and fire may escape
Exposes mineral soil for natural regeneration	Weather conditions limit opportunities for burning
Improves access for tree planting	Risk of erosion on steep (>35%) slope
Short-term control of brushy vegetation	Rapid recovery of some herbaceous species
Enhances wildlife habitat	Nitrogen, an essential plant nutrient, is lost during combustion

Mechanical

Mechanical site preparation has increased with the growing use of artificial regeneration since 1960, particularly mechanized tree planting. Plantation forestry often requires the site to be cleared of all debris, leaving practically bare ground. Shearing and raking removes large, heavy debris (**Figures 2 and 3**), whereas roller drum chopping incorporates smaller, lighter debris into the planting site (**Figure 4**). Single-pass mechanical site preparation averages $106 per acre.

Additional tillage is often needed. On dry sites, disking with offset harrows can be used to kill unwanted vegetation on the planting site (**Figure 5**). On wet soils, bedding is used to mound the soil along the planting rows (**Figure 6**). This operation elevates the planting site while providing some short-term weed control. Additional tillage costs range from $112 to $146 per acre, depending on the operation and number of passes.

Figure 2. Land-clearing involves shearing large material with a tractor-mounted blade or chain saw.

Figure 3. Once felled, debris is raked into piles or rows to complete the land-clearing operation.

Figure 5. Disking with an offset harrow controls competing vegetation by cutting and exposing roots. Disking can also restore the site from rutting and compaction during logging and land-clearing.

Figure 4. Smaller residuals are cut into pieces by a rolling drum chopper. The drum can be filled with water to add weight.

Figure 6. The bedding harrow cuts and mounds the soil into a planting row for enhanced drainage on wet sites.

Mechanical site preparation has evolved to better suit current needs. Instead of doing separate clearing, then raking, and finally tilling passes on the site, combination plows attached to tractors are used to shear and clear debris, subsoil, and make planting beds in one pass. These plows are used across the southeastern United States.

Since combination plows perform multiple operations in one pass, costs have been substantially lowered for those activities while reducing the environmental impacts. A combination plow that shears-rips-beds in one pass could reduce costs of multiple passes with heavy equipment.

Advantages	**Disadvantages**
Removes debris for machine-planting	Can be expensive
Exposes mineral soil for natural regeneration	Loss of fertility where topsoil is removed
Can improve soil physical condition	Not suitable on steep (>35%) slopes
Degree of site preparation easily varied	Rapid recovery of some herbaceous species
Control of existing competing brush	Unwanted woody species may seed in

Chemical

Herbicide use in forestry began after World War II but grew dramatically in the mid-1980s. Chemical costs stabilized, whereas mechanical site preparation costs were increasing. Moreover, herbicide formulations with broader effectiveness on competing (target) vegetation were developed. These formulations were also more environmentally acceptable. Forest herbicides allowed the land manager the ability to control vegetation while minimizing soil disturbance and, consequently, erosion. It is during this time period that some of the most widely used chemicals today made their first appearance.

Tank mixes of two or more herbicides permit the flexibility of combining chemicals to control a broader range of target vegetation using one application. New application technologies, such as helicopter spray booms, ground sprayers for skidders and all-terrain vehicles, and hand-held applicators, have further increased the use and versatility of herbicides in forestry (**Figures 7** and **8**).

For maximum effectiveness, the herbicide must be matched to the target vegetation, soil condition, application method, and time of year. A professional forester should make the herbicide prescription and application. Site preparation with herbicides ranges from $72 per acre when applied by ground equipment to $78 per acre when applied by helicopter in the Northern Coastal Plain.

Figure 7. Helicopter applications of herbicides on cut-over stands control residual vegetation before planting.

Figure 8. Advances in application technology for herbicides include smaller spray rigs for all-terrain vehicles.

Advantages	**Disadvantage**
Easily done on uneven or steep terrain	Requires technical input
Controls unwanted vegetation longer than other site preparation methods	Does not expose mineral soil for natural regeneration
Reduced compaction and erosion	Risk of drift or volatization of herbicide onto surrounding vegetation
Cheaper than mechanical methods	Potential for skips in application
Some residual herbaceous weed control	Debris left on site often necessitates hand-planting

Combinations

Often, a combination of chemical and mechanical methods with prescribed fire is used in site preparation. Such combinations include chop and burn, herbicide (spray) and burn, and chop-herbicide-burn. Combinations provide flexibility best suited for the site and regeneration method to control target vegetation.

Advantages	Disadvantages
Applied in a variety of terrains	May increase cost
Degree of site preparation easily varied	Weather may limit burning opportunities
Provides access for machine planting	Terrain may limit mechanical methods
Control target vegetation and reduce fuels	Mechanical method may damage site

Techniques on the Horizon

New mechanical equipment is being combined with herbicide use and fertilizer addition for pine plantation establishment. The use of herbicides in hardwoods is also increasing because there are formulations that work on herbaceous species only without harming hardwoods.

Site preparation in the future will continue to become more technologically advanced. Development of new herbicides and delivery systems will continue, as well as refinements in mechanical practices. In addition, the increased use of geographic information systems (GIS), satellite imagery, and global positioning systems (GPS) may result in precision forestry.

Precision forestry is similar to the term "precision agriculture" in that chemicals (herbicides or fertilizer) are applied on a micro-site basis. This reduces costs while maintaining environmental quality. For example, a land manager may be able to access satellite imagery for a given forest stand. Digital image processing in a computer could determine the type and location of vegetation. Soil and drainage patterns could be combined with the vegetation information in a GIS. An expert system could then provide the land manager with recommendations for herbicide and fertilizer applications. The GIS could generate a prescription map for the stand. This information could then be put into on-board computers for ground or aerial application of materials. An on-board GPS receiver would track the applicator's location and adjust the application rates of chemicals according to the prescription map.

Forestry is continually adapting to new market conditions and incorporating new science. Environmental laws relating to water quality will require current and new technologies to minimize potential detrimental effects of mechanical and chemical site preparation on forestlands. We will increasingly depend on new technologies to manage our forestlands in a more economical and ecological manner in the years ahead.

Reforestation Assistance

Both the federal and state governments provide numerous incentives to assist forest landowners with reforestation. They recognize that practicing forestry is expensive and that future wood supplies are important to the economy. These incentives include tax breaks and cost-share programs.

The federal tax code permits deductions for reforestation costs, whereas the Mississippi tax code provides the Mississippi Reforestation Tax Credit (MRTC) that landowners may use to recover reforestation expenses. For more information on these tax breaks, read Mississippi State University Extension Service Publication 2420 *Paying for a New Forest without Cost-Share Funding* (Henderson 2016). Note that the MRTC cannot be claimed for the same acreage enrolled in government incentive programs (described next), and it requires a reforestation management plan by a registered forester.

Both the federal and state governments also have cost-share programs to assist forest landowners directly with reforestation costs. Most of these programs offer a partial reimbursement for reforestation expenses. To apply, contact your local Natural Resources Conservation Service or Mississippi Forestry Commission office. Landowners must sign a contract to enroll before seeking an incentive reimbursement. Also, a landowner may only enroll in one government incentive program on a given area.

For More Information

Henderson, J. 2016. Paying for a New Forest without Cost-Share Funding. Mississippi State University Extension Service Publication 2420. 8p.

Henderson, J. and S. Dicke. 2016. Timber Tax Overview. Mississippi State University Extension Service Publication 2307. 8p.

Kushla, J. and B. Self. 2013. Herbicide Use in Forestry, MTN 18F. Department of Forestry Management Technical Note, Mississippi State University. 6p.

Maggard, A. and R. Barlow. 2017. Special Report: 2016 Costs and Trends for Southern Forestry Practices. *Forest Landowner*. September/October, pp 31–39.

Self, A. and J. Kushla. 2016. Mechanical Site Preparation for Forestry in Mississippi. Mississippi State University Extension Service Publication 3006. 8p.

Shilling, C. and R. Mills. 2010. Prescribed Burning in Louisiana Pinelands. Louisiana State University Agricultural Center Publication 1618. 20p.

Publication 2823 (POD-09-17)

By **John D. Kushla,** PhD, Extension/Research Professor, Forestry. Photos by J. D. Kushla.

MISSISSIPPI STATE UNIVERSITY EXTENSION

Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. GARY B. JACKSON, Director