FORESTRY - AS A POST MINING LAND USE IN APPALACHIA[1]

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The Appalachian coal province extending from Pennsylvania to Alabama has the highest percentage of commercial forest land for all coal regions in the United States. The oak-hickory, oak-pine, and loblolly-shortleaf pine forest ecosystems dominate in the region. Each of these ecosystems has distinctive soils, flora and fuma, and many commercial tree species are represented. It is logical that commercial forests become the land use on much of the reclaimed mined land. Historically, research in the Midwest and northern Appalachian Regions contributed information used to formulate reforestation guidelines for mined land reclamation in the Eastern United States. Many of the basic principles apply today, but the enactment of Public Law 95-87 has required new research initiatives to meet specific requirements of the law.

A historical review is appropriate to document the basis for reforestation practices on minesoils and to review trends in reforestation during four decades. The application of these basic principles to current reclamation standards and modifications of existing laws and regulations to encourage mined land reforestation will be discussed.

Early in the 1950's the potential environmental damage from surface mining began attracting attention. Improvements in mining equipment and the demand for coal indicated the acreage affected by surface mining would expand rapidly. It was also recognized there was little information regarding mined land revegetation. The configuration of the mining disturbance, the nature and properties of the minesoils, and the economics of the coal industry contributed to the decision to select tree planting as the primary means for restoring vegetation.

It was immediately apparent that little was known about the basic requirements for successful tree establishment on mined land. The U.S. Forest Service established a research team at the Central States Forest Experiment Station in Ohio. Individuals at Pennsylvania State University and Kent State University were also interested in the problem. The initial research concerned the basic fundamentals of tree planting. A serious problem was the inadequate supply and poor quality of available nursery stock. This required specialized training programs for state and federal nurserymen. Species adaptation trials dominated the early research as there was no consensus regarding species best adapted to site conditions on mined land. This was complicated by inadequate knowledge of the chemical and physical minesoil parameters that could affect seedling survival and growth. The most obvious and easily determined, pH, was used to determine which sites were plantable.

At the end of the first decade, progress had been made. Hundreds of acres of hardwood and conifer plantations had been established. The quality of nursery stock improved and there were adequate numbers of seedlings produced to satisfy demand. A stock grading system for conifers and hardwoods was developed. Preliminary results from species adaptation trials identified species suitable for planting on a range of site conditions.

This information contributed to an expansion of planting programs. Many mining companies recognized their responsibility for re-establishing vegetation on mined land and employed professionals who were responsible for reclamation activities. Research initiatives benefited from the cooperative attitude of the mining industry.

During the second decade, important political developments reflected the growing concern regarding the environmental impacts of surface mining. It had been demonstrated that reforestation of mined land was feasible and the results satisfied some of the environmental concerns. Legislation requiring the re-establishment of vegetation on mind land was enacted in a few states. These were followed by laws requiring "strike-off" grading. The undulating windrows of spoil were perceived by some to be esthetically displeasing and mine operators were required to level the peaks of the ridges of spoil.

Economic incentives and improved equipment made it possible to mine coal on the steep mountain slopes of West Virginia, eastern Kentucky, Virginia, and Tennessee. Contour mining, as this system was called, created high walls; relatively flat, narrow benches; and steep, unstable outslopes. The re-establishment of vegetation on this disturbance was difficult. Developments in hydromulching techniques made reclamation possible.

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Research priorities shifted to problem areas identified during the first decade. Species trials expanded with the availability of suitable planting stock. Trials to assess the acid tolerance of specific species were initiated. The overburden for many coal seams in Appalachia is acidic and some strata, when deposited on or near the surface, prevent plant establishment. It was common practice to avoid "hot spots", "slick spots", and areas covered with dark grey to black spoil. There was no segregation of overburden and the reclamationist had to contend with a range of materials deposited on the surface.

Innovative planting systems were evaluated. It was known that black locust was acid tolerant, made rapid growth under a range of conditions, and fixed atmospheric nitrogen. Further research showed that tree seedlings planted in association with locust utilized the available nitrogen and growth was accelerated. Studies evaluating the optimum percentage of locust in a stand determined a 25 percent mixture was appropriate for most sites. This information stimulated interest in other nitrogen fixing tree species and European black alder was selected as a promising candidate. The growth characteristics of this species permitted a higher percentage of alder in the planting mixture.

Mine operators, recognizing the species diversity that occurs in hardwood forests, developed planting mixtures utilizing several species of hardwoods. These were often planted as a bag mixture. One operator in Ohio planted a row of pioneer species, a row of species intermediate in succession, and a row of climax species and repeated this pattern over the site. Spruce, larch, and pine species were planted in pure stands.

The potential for increasing acid tolerance and improving growth on adverse sites by genetic selection was considered by researchers in Pennsylvania. Extensive research with hybrid poplars indicated some clones may be adapted to minesoils. Studies in Pennsylvania, Ohio, West Virginia, and eastern Kentucky identified several superior clones.

The possibility that genetic differences within a tree species could determine acid tolerance or growth under adverse conditions stimulated interest in provenance trials. The first of these evaluated Virginia pine from seed sources in Tennessee and eastern Kentucky. This study provided support for the concept of a genetic relationship to acid tolerance. Provenance trials with ponderosa pine and birch in Pennsylvania and Austrian pine in West Virginia and Pennsylvania provided supporting data.

The role of mychorriza in minesoil reforestation was first proposed by studies in Indiana. The importance of mychorrizal fungi was noted in a Pennsylvania study of natural succession on minesoils. A microbiologist in Georgia developed techniques for innoculating seedlings with endomychorriza. Comparisons of tree growth on minesoils confirmed a positive relationship to tree growth on all but the most acidic minesoils.

State laws requiring "strike-off" grading suggested that requirements to level mined areas would soon follow. An Ohio study was the first to show the effect of compaction on tree growth. The ridges and valleys of a mine were leveled and black locust was planted. Growth on the severely compacted former ridges was significantly less than the growth over the former valleys.

Near the end of the decade, concern for the environment increased and the erosion potential for barren minesoils became a specific concern. Trees would not provide adequate protection until crown closure at the age of 10 to 15 years. This was intolerable, and herbaceous ground covers were the logical remedy. Erosion control is particularly important on contour mines where the steep outslopes are difficult to revegetate and tree planting is hazardous.

Historically, the second decade represents a period when forestry dominated reclamation. The plantations established during this period will continue to provide economic benefits for decades in the future. Research and experience in this decade contributed to the development of reliable reforestation practices for mined land.

At the beginning of the third decade, the future of forestry as a land use objective on mined land in Appalachia was in doubt. The use of herbaceous ground covers was essential for erosion control, but this contradicted basic silvicultural practices for tree establishment. Furthermore, it had been demonstrated that leveled minesoils could be used for agricultural crops. This put forestry in competition with other land uses. The legal requirements imposed on revegetation practices and the desirability of immediate esthetic and economic benefits from reclamation placed forestry in a difficult position. During this decade, forestry relinquished its dominance to other land uses and assumed a relatively minor role in reclamation. There were sites planted to a deep rooted permanent tree cover for stability and trees provided effective screens and vegetative diversity. Occasionally, plantations were established that could contribute economic benefits.

Research priorities shifted and forestry received a smaller share of available funds. A priority concern was the need to develop reliable establishment practices compatible with the herbaceous ground cover requirements. Research in eastern Kentucky showed some tree species could successfully compete with selected warm season grasses and legumes. There were attempts to develop effective herbicide treatments, but the cost/benefit predictions were not encouraging to the land managers.

Mine operators concerned with the revegetation of contour mines adopted the practices of including black locust seed with their herbaceous mixture. None of the seed was scarified and the rate of application averaged about 3 pounds per acre. Much of this seed came from European seed sources. In general, the practice was successful and a tree cover was established. Black locust is a strong competitor and in 3 to 5 years achieved dominance over most herbaceous species. A lower ground cover density on the steep slopes favored black locust establishment. These are critical sites that require a permanent tree cover.

The costs of hand planting encouraged renewed interest in direct seeding. Black walnut and oak species had been successfully seeded in the Midwest. Pine seeding in Alabama was considered a realistic option until herbaceous ground covers were required. A mine operator in West Virginia seeded 3,000 acres by helicopter with a seed mixture that included herbaceous species--black locust, pitch pine, and European white birch. The amount of tree seed was minimal. Black locust was the most successful, but a few pitch pine did germinate and survive. The birch was not successful.

Direct seeding trials are continuing in West Virginia. A few shrub species may be recommended but inconsistencies for promising tree species preclude specific recommendations. The objective of this research is to identify a reliable tree and shrub mixture that can be sown with a compatible herbaceous cover by hydroseeding.

The end of the third decade found the future of forestry in the Appalachian Region in doubt. The value of trees as a stabilizing cover is not questioned and trees will be used for that purpose. Plantations covering large acreages are seldom attempted. In general, forestry now receives relatively low priority in reclamation planning.

Experience and research during the three previous decades developed reliable reforestation practices. Current overburden handling systems create a planting medium that favors high survival rates and excellent growth. There is the capacity and technical expertise to produce adquate quantities of high-quality nursery stock. In fact, the situation could not be more opportune for tree planting in the Appalachian Region. This makes the lack of interest in forestry in the Appalachian Region even more disturbing. A review of the economic, biological, and political factors assesses their contribution to the apathy regarding forestry.

Economics probably is not a valid concern in this situation as the additional costs associated with tree planting would represent a relatively small increase in the total cost of reclamation. Historically, the mining industry has accepted realistic demands that provide tangible benefits. Furthermore, those responsible for reclamation generally are not concerned about the rate of return from a forest plantation on the mine site.

A major technical problem concerns the use of herbaceous ground covers to minimize erosion until trees dominate the site. Basic to the problem are regulatory standards regarding acceptable ground cover density. These encourage densities that are excessive for the basic purpose of site protection and result in unnecessary competition to seedling trees. Modification of these standards, by accepting lower ground cover densities on areas planted to trees, is possible under present laws and regulations.

It has been demonstrated that warm season grasses and legumes are less competitive than cool season herbaceous plants. Some tree species, such as black locust, aggressively compete with dense ground covers. Therefore, it may be advisable to plant pioneer tree species initially rather than the climax species that grow slowly and do not tolerate competition. The proximity of forest stands to the disturbed areas and evidence from abandoned farm land indicate a wide range of tree species will invade reclaimed sites when conditions are favorable. The invasion of desirable tree species probably will be more rapid on sites having a canopy of pioneer tree species than an area with a dense grass and legume cover. Direct seeding tree and shrub species is a viable option. It could reduce establishment costs and provide a system for establishing seedlings on steep slopes that are potentially hazardous for hand planting crews.

The regulatory agencies can stimulate interest in forestry by permitting minimum requirements for site preparation, encouraging innovative establishment procedures, and establishing realistic bond release conditions. Regulations applying to agricultural crops establish a precedent that justifies this recommendation. It will complicate the regulatory process, but the current level of expertise in most regulatory agencies should accommodate increased regulatory flexibility.

Recognition of the unique characteristics of forest soils in the Appalachian Region is as important as standards for agricultural land in the Midwest. Forest soils are often thin, acidic, stoney, and relatively infertile. The A-horizon, when it does exist, is seldom more than an inch or two in thickness. Selective handling of the overburden during mining and regrading often creates an improved growth medium for trees. Potential rooting depth is increased and the subsurface moisture regime will at least equal and probably exceed premining conditions. Shattering and mixing the overburden can increase the nutrient base. Stoniness and acidity will be similar to the original forest soil. Plantations throughout the region testify to the suitability of minesoils as a growth

medium. When tree planting is contemplated, regulations should allow physical and chemical characteristics of the minesoils to be equivalent to the properties of local forest soils.

The requirements to redistribute a top dressing, composed of the A and B horizons, involve questionable cost/benefit ratios for forest management. Therefore, this requirement should be optional and evaluated on a site-by-site basis. These recommendations do not compromise state and federal laws. They recognize the basic principles of forest ecology and utilize past research and experience.

Regrading standards for forest plantations should differ from those required for intensive land management. The establishment and management of tree plantations can be successfully and efficiently accomplished on sites having steep slopes; more frequent undulations; and a rough, rocky surface. Not only do these recommendations simulate natural conditions, they reduce compaction and create topographic diversity characteristics of forest stands.

Politically, there needs to be a greater recognition of forestry as a legitimate land use. It is perceived by some policy makers that forestry is not as desirable a post mining land use as agriculture, pasture, or forage. It is approved only when no other use seems practical. An Appalachian state that uses the land use designation "woodland-wildlife" to identify areas that may be planted to trees, typifies the low regard for forestry.

There are also situations where the regulatory authority should exercise discretionary powers on a site specific basis when forestry is, for technical reasons, the only reasonable post mining land use. In many localized areas, where the productivity of the land has been destroyed by decades of mismanagement, the reclamation plan should require tree planting. Steeply sloping land that cannot be cultivated, mowed, or grazed should have a tree cover. This situation commonly occurs in mountainous regions where steep slopes result from highwall elimination. It is also logical to require tree planting when the premining land use is exclusively forestry and the site is isolated from agriculture and grazing activities.

The legitimacy of forestry as a post mining land use may be enhanced by informing those responsible for reclamation policy and the public of the potential regional economic benefits from the establishment and management of plantations. These benefits will be in direct proportion to the condition and productivity of the forest stand that will be destroyed by mining. In Appalachia, indiscriminate cutting, frequent wild fires, and lack of management have created forests with no immediate value and little, if any, economic potential. The hopelessness of the situation is not apparent to those who do not understand forest management because the mountain slopes are covered with many trees. Many of these forests are currently unmerchantable and restoration to productivity by intensive silvicultural practices is impractical. Therefore, reclamation following surface mining provides a unique opportunity to re-establish a productive forest. The species planted will have a predictable economic value. Spacing and planting arrangements can provide maximum productivity per unit area. The conversion of a virtually worthless forest stand to a plantation with predictable productivity can be accomplished quickly and at no cost to the land owner or public.

Unfortunately, the current attitude toward forestry in the Appalachian Region and the prospects for increased interest in tree planting are not good. This is incongruous with the high percentage of forest land in the region. Factors that have contributed to this situation have been discussed and recommendations for stimulating interest in forestry have been made. Changes in attitude and regulations are necessary to dispel the apathy that exists regarding forestry as a post mining land use in Appalachia.