REFORESTATION AND WATER RESOURCES OF THE YAZOO-LITTLE TALLAHATCHIE WATERSHED

by

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The watersheds of the Little Tallahatchie and Yazoo Rivers of north Mississippi have the dubious distinction of being among the most severely eroded in the Eastern United States. My subject today is the role of reforestation in improving the hydrologic condition of this area.

A survey in 1940 reported that the infiltration capacity of the soil had been so reduced that less than 1 inch of rainfall caused floods in some minor tributaries. Two-thirds of the bottom lands suffered damage from annual flooding. Each year more than 100 million tons of sediment were flushed from the hills into the valleys and stream channels. Annual damage from floods and sediment exceeded $4.5 million (1, 2).

The first remedial action began in 1936, when the Corps of Engineers started a comprehensive project based primarily on construction of large detention dams on the four major tributaries of the Yazoo. The last structure was completed in 1954.

The dams gave immediate protection to farmlands of the Mississippi alluvial plain and, with the advent of the Yazoo-Little Tallahatchie (Y-LT) Flood Prevention Project in 1946, the Soil Conservation Service started to build additional floodwater detention dams on the smaller tributaries. Some 250 water-retardation structures now protect more than half the bottom land within the hill area formerly subjected to flooding. But to ensure a reasonable working life for such structures, it was necessary to stabilize a half-million acres of eroding hills behind them.

The worst of the eroded lands were relegated to forest use. Many were at a point where they were regarded as worthless. They could not be ignored, however, for they were the source of high rates of runoff and much of the damaging sediment. Some small gully plugs, for example, filled with sediment within a year or two.

1/ Maintained by the Southern Forest Experiment Station in cooperation with the University of Mississippi.

The need was to stabilize the exposed earth; the problem, to select suitable plants. The task was difficult. Vast acreages were losing several area-inches of soil each year. Any disturbance of the soil increased the erosion hazard to the point that a single severe storm could cause great loss; this threat generally ruled out any soil preparation necessary to establish vegetation from seed.

Sodding, following land forming and the application of soil amendments, stops erosion but is costly. It has therefore been limited to high-risk areas and to situations where physical improvements must be protected.

Over the years, Y-LT technicians tested a hundred or more herbaceous and woody species on eroded sites--are still testing, in fact. African weeping lovegrass (*Eragrostis curvula* Schrad.) has emerged as the most promising grass and is widely used. It has many of the requirements of an ideal erosion-control plant. For site preparation, a mere scratching of the surface suffices. Lovegrass does well without maintenance fertilization, withstands deep and continued siltation, and is a low-preference food for livestock. It is a bunchgrass, however, and provides neither the volume nor continuity of soil cover desirable for optimum soil stabilization.

Several other plants have been found useful for specific situations--kudzu (*Pueraria thunbergiana* [S. & Z.] Benth.), honeysuckle (*Lonicera japonica* Thunb.), and the lespedezas (*Lespedeza* spp.)--but none are suited for wholesale application.

Funds were limited, and the Y-LT managers ultimately were faced with a choice. They could try to secure immediate stabilization of a limited acreage, or they could elect to treat at least 10 times as much and wait 5 to 10 years for control. The decision was not difficult, considering the large acreage awaiting action. It was to plant trees--mostly loblolly pine (*Pinus taeda* L.).

Of the various plants tested for erosion control, loblolly pine had been found to combine more desirable traits with fewer disadvantages than any other species. Research has developed methods for establishing loblolly on almost any site (3). Properly planted, it will hang on and grow better than any known plant.

Over 500,000 acres of loblolly plantations have been established--about 1 acre in every 8 of the hilly uplands of the watershed. While some plantations are still too young to be fully effective, studies of the U. S. Forest Service's Forest Hydrology Laboratory at Oxford, Mississippi, are giving some indications of how the stands control sedimentation, reduce storm runoff, and conserve water supplies.

SEDIMENT CONTROL

The immediate objective of vegetative measures on eroded sites is to provide a protective mat that will prevent further soil loss and site deterioration. The most effective soil cover is a layer of litter provided and perpetuated by a forest stand. For this purpose, loblolly pine has no peer. It survives well, grows fast, casts more litter than other species, and requires little maintenance. A half-inch depth of pine litter on the ground will halt the gross movement of sediment. On most eroded sites loblolly will produce this much in 5 to 8 years.

A deeper and continuous forest floor is, of course, desirable, and soil loss is reduced progressively as the litter accumulates. During the first 10 years the forest floor accumulates 3 to 5 tons per acre. The weight increases to about 7 tons per acre at age 20, and may again double by the end of the third decade.

The value of the litter for erosion control was demonstrated by gaging three small catchments of 20-year-old pines established on deeply eroded soils. Annual sediment yields during a 3-year period averaged 34 pounds per acre, as compared to between 1 and 2 tons from hill pastures, 20 tons from cultivated lands, and 182 tons from gullies (4). The low yield from the pine catchment was due partly to the small amount of runoff. However, the average annual concentration of sediment per unit of runoff was less than that from hardwood stands not having a history of severe erosion. Thus in less than two decades the pine on these lands had reduced the sediment to amounts probably not in excess of the norm for undisturbed forests that once covered the area.

REDUCTION OF SURFACE FLOW

The effectiveness of pine plantations in reducing storm runoff is less clear-cut than their efficiency in preventing erosion. Here soils are involved, as well as cover type.

The amount of runoff is determined, first, by conditions at the soil surface, for rain that cannot penetrate the surface must run off. It is also determined by the storage available in the upper soil layers, because the capacity of the soil (like that of any other vessel) cannot be exceeded.

Studies indicate that loblolly plantations will decrease storm runoff from medium- to well-drained soils. For example, water yields from the three small catchments previously cited averaged about 1 area-inch per year. How much of the rainfall ran off before the plantation was established is unknown, but it was sufficient to remove 1 to 2 feet of topsoil and cut gullies up to 6 feet deep. These catchments will now accept rain intensities of 5 inches per hour for 15 minutes, 10 inches per hour for 5-minute periods, and 6 inches of rain in 24 hours. The clear inference is that pine creates soil surface conditions favorable for water intake. Considerable reduction of runoff is probable on well-drained soils of sandy and medium texture even where the topsoil has been removed.

On some soils significant reduction in runoff may not be realized, or a reduction may require more than one rotation of pine. These include soils eroded to a dense horizon and soils with a restrictive pan at shallow depths. Under such conditions permeability is limited, and the upper soil remains near saturation during most of the wet winter season. The opportunity for storage is small and the excess rainfall runs off. Small catchments of hydrologically shallow soils with covers of loblolly pine and mature shortleaf pine-hardwoods have yielded up to 25 percent of the annual rainfall as runoff. On such areas, the soils and not the cover type determine the amount of runoff.

We have found, however, that while cover may not greatly alter the amount of runoff from hydrologically shallow soils, it may significantly alter the rate of runoff. Burning a small catchment of native grass on a pan soil, for example, did not increase total water yield but did significantly increase peak flows. Although the grass made good regrowth following the burn, the increases in peak flows have persisted for 3 years and appear to be related to small changes of surface litter. Other studies have confirmed that pine plantations effectively minimize sediment production despite high quantities of runoff. Annual sediment from five small gaged catchments over a 2-year period averaged only 32 pounds per acre-inch of runoff. Thus, although flood-retardation structures are needed where rates of runoff are high, the pine will ensure that the structures will serve their expected useful life.

WATER SUPPLY

While erosion control and flood prevention are first considerations in managing any watershed, ground-water supplies are vital in the long view. Ground water--the only water reserve--is a basic commodity, and, as water demands grow, the value of water will increase. Protected and replenished, the ground-water reserve will become increasingly important in meeting a large part of the future municipal, industrial, and agricultural demands of our thirsty populace. Its importance to the economic growth of the South is evident when it is known that an estimated 40 percent of the Nation's ground water is in the South. Now we have an abundance of water, but there are signs that, despite vast reserves, shortages will develop in areas of concentrated needs.

North Mississippi, which has more than a fair share of the South's ground water, is underlain by deep strata of sands and clay of vast storage capacity. They are highly productive aquifers, and their unsaturated upper levels function as water-storage or flood-prevention impoundments. The new pine forests of the Yazoo-Little Tallahatchie will help ensure that these natural reservoirs are utilized. Rainfall that runs off the surface can be considered waste. It requires control by expensive dams, channel improvements, and levees. Water that enters the ground-water reservoir becomes available for plant growth and feeds streams in dry weather. There is no better way to reduce damaging surface flows on the erosion-scarred hills of north Mississippi than to establish forests on the permeable outcrops.

Thanks to an abundant rainfall, we can manage our ground water for sustained yield. The most logical way is through management of our forests, particularly on permeable outcrops. Such outcrops supporting pine plantations can store and slowly release 15 to 20 inches of the annual rainfall. Once enough forest litter has been accumulated to hold the soils in place and maximize water intake, the forests probably can be managed to reduce evapotranspiration and thus increase contribution to ground water--when and where needed. Frequent thinnings seem to offer good possibilities for such management. Eventually, on certain key outcrops, water value may be so great that maximum water yields will be a primary objective in forest management.

To sum up: The pine plantations of the Yazoo-Little Tallahatchie watersheds are performing their hydrologic functions well. They are reducing sedimentation and are restoring the ability of permeable outcrops to accept and store the rainfall, thus reducing floods.

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