FOREST CLEARCUTTING AND SITE-PREPARATION ON A SALINE SOIL IN EAST TEXAS: IMPACTS ON WATER QUALITY

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Abstract--Three 0.02 hectare plot-watersheds were installed on a saline soil in the Davy Crockett National Forest near Apple Springs, Texas. Each plot was installed with an H-flume, FW-1 automatic water level recorder, Coshocton N-1 runoff sampler, and two storage tanks. One watershed was undisturbed forested and served a control, one was clearcut without any site-preparation, and the third was clearcut, V-blade sheared, windrowed, and vegetation regrowth was prevented for the first 2 years. A total of 274 storms were recorded during the four-year study period, 1989-1992. Average annual sediment losses for the study period were 55, 197, and 1,530 kilograms per hectare per year for the control, commercial clearcut, and sheared plots, respectively. These losses are about average for most studies conducted in East Texas and the Southeast and are well below average losses for all land uses in the Southeast. Sediment losses and surface runoff were significantly greater from the sheared plot-watershed than from the control and the commercial clearcut plots. Employing Wischmeier and Smith's (1978) long-term average R-value for the USLE overestimated annual sediment yield for the study period, while two shortcut models developed in the United States resulted in more accurate predictions and are good substitutes for the long-term R-value. Total losses in surface runoff of PO_4, NO_3, NO_2, TKN, K, Ca, Mg, Na, Al, Fe, Zn, and Cu were higher on the site-prepared plot watershed than the other two. Losses of PO_4, TKN, and NO_2 were higher on the commercial clearcut plot than the control. Losses were not high enough to adversely affect forest productivity. Concentrations of elements were generally below established USEPA surface water quality standards and were not high enough to adversely affect plant growth.

INTRODUCTION

Commercial clearcutting is the most common silvicultural system employed for the regeneration of upland forests in East Texas. Following harvest, sites are usually prepared for planting by mechanical techniques such as shearing, chopping, bedding, ripping or some combination of these activities. Concern has arisen regarding possible degradation of site productivity over time and possible degradation of water quality (USEPA 1993).

There are more than 120,000 hectares of somewhat poorly drained, upland saline soils in central East Texas (between Sam Rayburn Reservoir and Livingston Reservoir). These soils have high salt concentrations, low permeability, and are frequently saturated. Upland vegetation is predominately mixed pine/hardwood, with loblolly (*Pinus taeda*) and shortleaf (*Pinus echinata*) pine dominating the overstory. Conversion of these natural stands to plantations can be difficult, reporting as many as three attempts with no success in some areas. J-rooting and limited lateral root development at about 15 centimeters below the surface is frequently observed on theses sites. High mortality rates are thought to be the result of a rise in the water table following harvest, seedlings experiencing salt toxicities, nutrient imbalances, or some combination of these factors. Surface runoff from clearcut sites on these soils could negatively impact water quality as well.

This study was initiated in 1988 to examine the impacts of clearcutting and site preparation on sediment movement and water quality from a saline soil in East Texas. The results from the first two years were presented in Sayok and others (1993a and 1993b) on sediment and element movements and Chang and others (1992) on applications of the universal soil loss equation. Effects on soil properties were reported in Chang and others (1994). This report summarizes the results of all four years of data collection.

METHODS AND PROCEDURES

Study Area

This study was conducted during the water years 1989 through 1992 in the Davy Crockett National Forest near Apple Springs, Texas, about 200 kilometers north of Houston and 250 kilometers southeast of