Revised modeling used to evaluate impacts of management and rotation on wood-flow and profitability from CRP pine plantations in Georgia.

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Abstract

Only 2.5 million acres (6.8 percent) of the 36.5 million acres enrolled nationwide in the Conservation Reserve Program (CRP) were planted in trees. However, in the South, establishment of pine plantations was the predominant practice. In Georgia, 91 percent of the 706,456 CRP acres were planted in pine. Previously developed growth models for these stands project growth at a rate of approximately two cords per acre per year on a 20 year rotation. A new study completed by Pienaar and Rheney provides revised tree growth data for oldfield loblolly plantation. These revised growth estimates were used to model management options for short (20-year) pulpwood rotations. Wood-flow and financial returns are examined for expected output attainable. Revised modeling results were 14 to 24 percent above those obtained using previous old field pine plantation growth models. CRP tree plantings increase total agricultural income $98.4 million annually, create 364 jobs, and increase total personal income $10.8 million. Available wood-flow from CRP stands peaks in 2006 at over 12 million cords available that year. CRP pine plantations represent a viable long term economic and environmentally sound alternative to row crop production on erodible soils. Results of this study contribute directly to ongoing legislative and public policy deliberations.

Introduction

Georgia is one of the largest agricultural states in the U.S. southeast with 3.17 million acres of soybeans, wheat, rye, cotton, peanuts, oats, and corn production annually (GASS 1996). Overall, of the 37,140,514 acres of land in the state, 4,191,6000 acres are in planted agricultural crops and 24,136,737 are forest land acres (Bachtel and Boatright 1995, GASS 1996). Enrollment in the Conservation Reserve Program diverted 706,456 acres, or 16 percent of currently utilized cropland. Pine plantations were established on the majority of these acres.

Nationwide, tree planting accounts for only seven percent of all CRP practices. However, throughout the South, tree planting, primarily establishment of pine plantations, was the predominate CRP practice, with 76.6 percent of CRP acres in the southeast and 91.4 percent of CRP acres in Georgia planted to trees (Table 1). Since the first signups in 1986, Georgia landowners have enrolled 645,931 acres under the tree planting provisions of the CRP. This effort leads the nation in CRP tree planting.

Enrollment in the Conservation Reserve Program (CRP) to establish vegetative cover crops on "marginal" highly erodible cropland was supported by an initial cost-share payment to establish the alternative practice followed by annual payments over a 10-year contract period. The annual payments provide compensation for the loss of crop production cash income on these erodible acres and serves as a short-run incentive to adopt a conservation practice. The CRP, which in part targeted highly erodible crop land for conversion to less intensive uses to protect soil and water resources and to reduce the production of surplus commodities, resulted in changes throughout rural agricultural-based communities (Siegel and Johnson 1993). The impact of these changes reflects the reallocation of capital used to produce annual crops, receipt of cost-share and annual CRP payments, the future market value of fiber and timber production along with potential shifts in the agricultural support infrastructure within communities (Moorhead and Dangerfield 1995).

The authors have previously examined CRP tree planting impacts in Georgia using oldfield gowth models to predict stand growth and yield (Dangerfield and Moorhead 1996; Moorhead and Dangerfield 1995, 1996a, 1996b). These models were based on plantations established in the 1960's and 1970's. Many foresters speculate that CRP stands appear to be outperforming past oldfield plantations, at least at early ages. Using recently released data on CRP plantation

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growth and yield we have revealuated prior growth and yield predictions, and related economic projections.

Table 1. U.S. and southern region Conservation Reserve Program enrollment: total acres and tree contract acres for signups 1-12, March 1986 to June 1992.

Region	Total Acres	Tree Acres	Percent of Total
U.S.	36,422,733	2,487,767	6.8
Southeast	1,692,580	1,297,565	76.6
Georgia	706,459	645,931	91.4

Research Base

A study done by Pienaar and Rheney (1996) examined the growth of oldfield pine plantations enrolled in the CRP. They examined the maximum wood-flow attainable under stand conditions where all competing vegetation is eliminated, as well as expected wood-flows under growing conditions expected to be found in oldfield pine plantations, i.e., some weed competition, stand mortality, etc. In all cases, growth rates were substantially greater than those used to develop oldfield models on these sites in the past.

At stand age 16 years, Pienaar and Rheney estimated total merchantable volume yield for old-field loblolly plantations to be 6,278 ft^3 per acre with an average annual growth rate of 392 ft^3 per acre. This projects that new plantations can provide the same level of total production on only 59 percent of the acres of the former land base in previous plantations. The basis for the increased production is in a higher level of competition control than previously practiced.

These expected growth rates have been approximated in the modeling for this study and are intended to serve as a guide for landowner and forest industry expectations of future oldfield growth rates and financial returns.

Objectives

The revised growth and yield data was used to: 1) model loblolly pine plantation performance; 2) revaluate the impacts to the state economy from diverting row-crop acres into the CRP; 3) revise impacts of CRP tree acres on agricultural and personal income, and resulting employment in Georgia; 4) model a 20-year pulpwood rotation based on soil productivity; and, 5) estimate total CRP pine plantation wood-flow over time.

Methods

Enrollment records for the twelve CRP signup periods were obtained from the Georgia state office of the Consolidated Farm Services Agency (Moorhead and Dangerfield 1995). Acres were examined by Land Capability Classification to predict a soil's suitability for crop and timber production. YIELDplus 4.0 by Hepp (1994) was used to model wood-flow, and perform economic analyses on loblolly pine (*Pinus taeda*) old-field plantations using a range of site index averages for CRP soils.

The economic impact of the CRP program was evaluated using a three stage ordinary least squares (OLS) model (Dangerfield and Miller 1991). The first stage equation models county sales from agriculture and forestry as a function of county production levels. Revised plantation yields were entered into the first stage of the model. The results from this equation are then used along with agricultural sales, number of wholesale firms, and the number of manufacturing and government employees, to predict total county employment in the second equation. The third equation uses total county employment to predict total personal income.

Results

Land capability classes IIe, IIIe, and IVe represented 58, 25, and 17 percent, respectively, of the CRP acres enrolled in Georgia. Each of the classes represent moderate to severe crop production limitations (Smith 1991). Establishing tree plantations in the CRP had immediate impacts on the state. The annual losses generated from annual crop production were stemmed. One-time cost share payments of $22,090,840 million were received by landowners to establish pine plantations, and $27,813,789 million in annual payments for the 10-year contract.

Despite the marginal nature of the CRP soils to profitably produce annual crops, these sites were found to be highly productive for pine plantation management. Prior established site productivity on the CRP land classes averaged 62 feet for dominant and codominant trees at 25 years ($SI_{25}62$). It has now been determined by Pienaar and Rheney (1996) that residual nutrients applied to past crops and the lack of hardwood competition has increased site productivity above published soil survey values. To account for this increase in site productivity, and to match height growth in the Pienaar and Rheney study, wood-flow projections of the existing growth and yield models were increased five feet in height of the dominant and co-dominant trees at age 25-years and examined for low, medium, and high site productivity, SI_{25} of 65, 70, and 75 feet respectively. Wood-flow projections increased 14 to 24 percent using the revised model inputs (Table 2). Financial performance was dramatically improved in response to the increased yields. Internal rate of return (IRR) increased 3.9 to 4.5 percent, and net present worth (NPW) doubled to tripled across site productivity classes. (Table 3).

For a long term perspective, the annual equivalent value of the "average" medium CRP site was $58 per acre. Multiplying the annual equivalent by the 645,931 acres enrolled in the CRP, yields an net annual wood-flow return of $37.5 million. The conversion to CRP tree plantations eliminates the $60.9 million annual loss by the double-crop of soybeans and wheat, and earns an additional $37.5 million annually for a net annual increase of $98.4 million in total agricultural income state-wide.

Table 2. Planted old field pine wood-flow projections for 20-year, unthinned Loblolly pine in Georgia.

	Harvested Cords			
Site Productivity	**Old Model**	**New Model**	**Change**	**Percent**
Low	37	46	+9	24
Medium	43	51	+8	18
High	49	56	+14	14

Table 3. Planted old field pine financial performance projections for 20-year, un-thinned Loblolly pine pulpwood rotations in Georgia. Values in parenthesis are old model estimates.

Site Productivity	**NPW[2] /acre**	**IRR[3] %**	**AEV[4] $/acre/year**
Low	332 (94)	15.8 (11.3)	34 (10)
Medium	410 (147)	16.7 (12.6)	42 (15)
High	499 (209)	17.7 (13.8)	51 (21)

[1] 8% discount rate; 1986 Prices: PW = $25/cord, C-N-S = $44/cord, ST = $164/MBF (PW inflated at 3.5% per year, ST inflated at 4.0% per year); 1997 Price-equivalents: PW = $35/cord, C-N-S = $62/cord, ST = $243/MBF.

[2] Net present worth is calculated with revenues discounted to present year less costs discounted to present year at an 8% discount rate. A net present worth value greater than zero indicates that at least the discount rate is being earned on the investment.

[3] Internal rate of return is the interest rate at which discounted revenues equal discounted costs. It assumes that all intermediate revenues are reinvested into the project. A project is considered profitable if the internal rate of return exceeds the discount rate.

[4] Annual equivalent value is the net present worth expressed as an annuity over the planning horizon, computed at the discount rate. Annual equivalent value is a useful measure for comparing investments over unequal time periods.

These CRP plantations have a potential annual stumpage value of $50.7 million once landowners can begin to thin these stands. As thinning operations become regulated, the counties would receive the additional benefit of harvest tax revenues of $1.3 million a year, based on an average ad valorem property tax rate of 25 mills.

CRP pine plantations are projected , as a result of the direct initial revenues received through cost share and annual payments, and the net increases from plantation management, to create 364 jobs and increase total personal annual income $10.8 million in the state as estimated using the OLS economic model. This serves to partially offset the loss of 437 jobs and $13.03 million in total personal income from the financially unprofitable and ecologically unsustainable annual crop production alternative on the CRP site. Siegel and Johnson (1991) projected a similar response to enrollment in the CRP in Virginia. Declines in agricultural production, jobs and personal income loss were countered by CRP payments to farmers and the economic activity resulting from the establishment, maintenance, and subsequent harvest of tree crops.

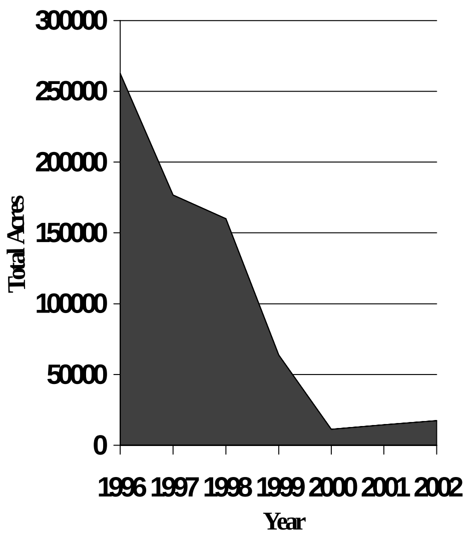

Figure 1. Release of Conservation Reserve Program acres from initial 10-year contracts.

The tree plantation acres under the CRP program will be released from the 10-year commitments beginning in 1996 extending through 2002 (Figure 1). The bulk of the acres, 547,748 (85 percent of the total), will reach contract end by 1998. The bulk of the acres from the 20-year pulpwood rotation will be available for harvest from 2006 to 2008. In 2006, total production equals 3.0, 6.1, and 9.1 million cords at 25, 50, and 75 percent of eligible acres harvested (Figure 2). By 2010, total volumes fall to 131, 263, and 394 thousand cords at the respective harvest rates.

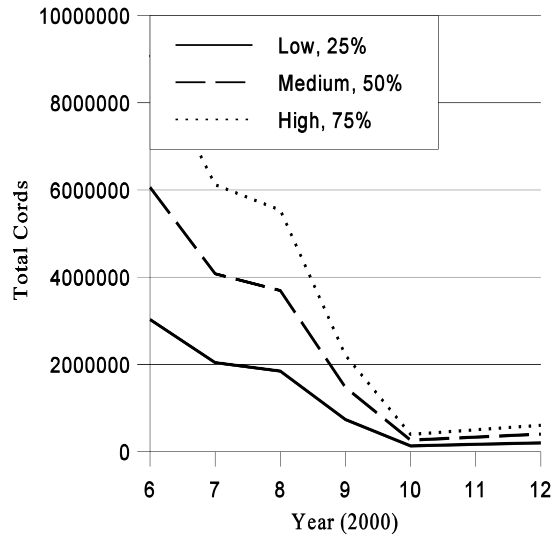

Figure 2. Total cord production in 25, 50, and 75 percent of the total Conservation Reserve Program acres available for harvest in 20-year pulpwood rotations, in Georgia

Implications

The CRP in Georgia effectively targeted erosion prone soils for conversion to conservation crops. Examinations of land capability classes indicate that only erosion prone, productivity limited land was enrolled in the CRP in Georgia. The average erosion rate before the CRP was 13.59 tons/acre/year, and was reduced to 1.08 tons/acre/year on soils in the program (EWG 1995). Therefore, major CRP objectives of reducing soil losses and improving water quality were achieved. All land capability classes enrolled had moderate to severe crop production limitations. Analysis of the typical crop production system on these soils revealed consistent and substantial annual losses, which ultimately lead to abandonment of these soils for crop production.

The CRP provided an attractive incentive for landowners to switch from intensive annual row-crop production to timber production through the establishment of pine plantations. Landowners received income through program enrollment from initial cost-share payments to establish practices, and the subsequent ten years of annual payments. Pine plantations established on CRP acres produce positive economic returns while effectively conserving soil resources for the future.

Modeling the 20-year pulpwood rotations indicated profitable enterprises. Haynes (1995) projects a 35 percent increase in softwood harvests from 1990 to 2040. Real prices of softwood sawtimber and lumber are expected to rise steadily from present levels until 2010 to 2015. Maturing pine stands on both industrial and non-industrial lands, including the nearly 1.3 million acres of CRP in the South will support these increases.

Longer tree rotations provide landowners improved flexibility to meet multiple objectives and can spread risks of timber production over longer time periods and more product markets. The Soil Conservation Reserve Program of 1956 to 1960 (SCRP) resulted in an impressive retention rate of 96 percent over 30+ years since the program began (GFC 1976, Kurtz et al. 1994). These stands continue to produce fiber and solid wood products and represent permanent conversions of erodible, marginally productive crop land to a viable long term financial asset. In Georgia, 82 percent of the landowners enrolled in the CRP indicated that they will continue timber production after expiration of the annual contracts (Kammholtz 1996). Following harvest of these stands 70 percent intend to replant these acres in pine. This compares favorably with the history of the SCRP pine plantations in the state.

Overall, the CRP likely represents a long term addition to Georgia's forest land base as did the SCRP. Wood-flows from longer rotation management scenarios from 2004 through 2025 fit well with projected state and regional fiber and sawtimber demands. Additionally, marginally productive land was effectively diverted from unprofitable annual row crop production with significant reductions in annual soil loss.

Acknowledgments: The authors thank the staff of the Georgia Consolidated Farm Services Agency for providing CRP records and land classification summary information. Paul Riddle, University of Georgia Cooperative Extension Service Director in Laurens County provided crop production records and information on cropping systems and practices on CRP acres. The authors also thank L.V. Pienaar and J.W. Rheney, University of Georgia D.B. Warnell School of Forest Resources for providing valuable assistance to extend their research to forest landowners.

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