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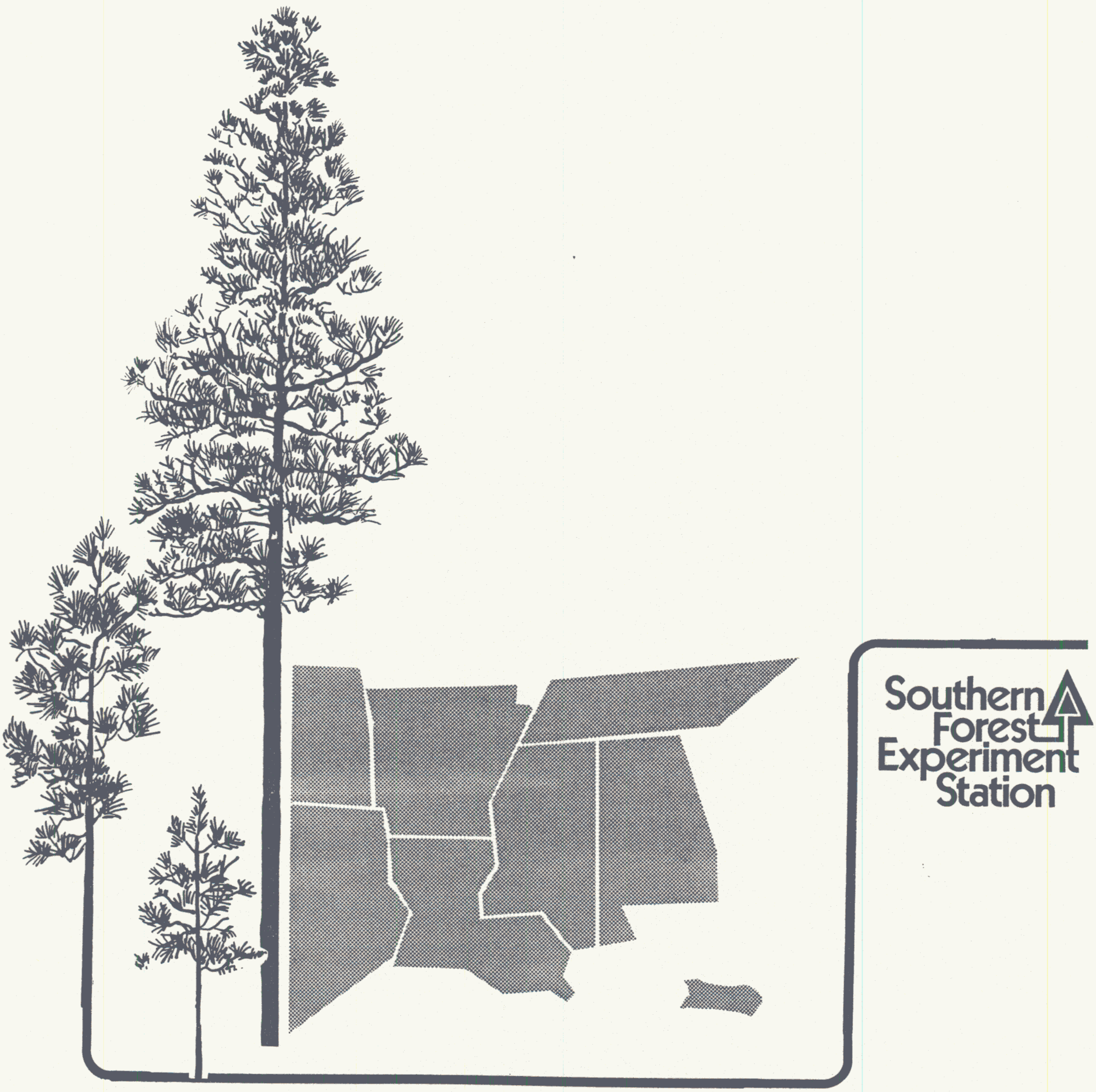

Harvesting Small Stems--
A Southern USA Perspective[1]

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ABSTRACT

Operations that harvest small stems using conventional equipment are discussed. A typical operation consists of rubber-tired feller-bunchers with shear heads, rubber-tired grapple skidders, and in-woods chippers. These systems harvest the small stems either in a pre-harvest, post-harvest, or integrated-harvest method.

INTRODUCTION

For many years, conventional harvesting operations in the southern U.S.A. have left many tonnes of usable biomass on the site to be disposed of during re-establishment activities. These conventional operations best utilize the pine component of the stand, removing bole wood that is suitable for pulp, chip-n-saw logs, plylogs, and sawlogs for larger band sawmills. The hardwood component removed would include only the species in demand for pulp and sawlogs and only that portion of the stems (merchantable bole wood) that is usable for those productions. As a result, no more than 60 percent of the above-ground biomass is removed.

The Arab oil embargo of 1973-74 caused many firms to examine alternative sources of fuel to supply their energy needs. This unused forest biomass offered forest products firms an easy substitute for the fossil fuels being utilized at that time. Pulp mills could usually increase the consumption of woody biomass for fuel (energywood)

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since bark and wood residues of the pulping process were already being burned in the boilers.

During the late 1970's and early 1980's, many firms experimented with methods of recovering the unused biomass left on sites using conventional operations. Four approaches to recovering energywood evolved. A first approach involved the development of specialized equipment to recover both the logging residue on the site and the smaller standing stems. These efforts are reported by Stokes, Sirois, and Watson (1989) elsewhere in these proceedings. The other 3 methods of recovering this energywood involved the use of conventional equipment to harvest this material either as

1. A post-harvest operation following conventional logging,

2. A pre-harvest operation prior to conventional logging, or

3. An integrated operation which removed both the roundwood products and the energywood in a single pass.

ENERGYWOOD OPERATIONS

All of the energywood operations which harvested standing stems utilized:

1. Feller-bunchers with shear type felling heads,

2. Grapple skidders for in-woods transport,

3. Stationary inwoods chippers for commutation, and

4. Tractor trailer rigs with chip vans for transporting the chips to the end-using boiler.

The shear type feller-bunchers were used to build large bundles of stems for the grapple skidders. Rubber-tired carriers for the felling head were favored because large bundles of stems could be assembled to enhance the production of the grapple skidders.

The post-harvest system was the most prevalent method of harvesting the energywood. Few small stems were utilized in the post-harvest system since most of the small stems were knocked to the ground by the conventional logging operation which preceded the energywood harvest.

The most successful recovery of the small stems was carried out by the preharvest or integrated harvesting operations. These operations were studied in detail by Watson, Stokes, and Savelle (1986); Miller et al. (1987); and Broussard, Watson, and Stokes (1987).

Per-harvest of Energywood

Scott Paper Company of Mobile, AL, began preharvesting energywood in 1982. Scott had installed a large wood-fired boiler to supply their pulp and paper mill's energy requirements and were using the surplus steam to produce electricity to be sold to Alabama Power Company. Much of their holdings being harvested contained 50 or more tonnes of material per hectare that would not be utilized with conventional operations. Scott began their development of energywood harvesting operations with two crews and have now expanded to 8 crews totally dedicated to the harvest of energywood with a production goal of 45,000 tonnes per crew per year.

Scott's operations utilize all stems 2 cm dbh and larger which have no utility for other products. The preharvest for energywood is scheduled to precede the harvest of higher-valued products by 1 to 12 months. Table 1 gives utilization results for the recovery efficiencies observed in tests in 3 separate locations in Mississippi and Alabama. The cost of delivering the energywood chips into a chip van is reported in Table 2 along with of the various cost components of an energywood harvest.

Table 1. Utilization of above-ground biomass including the recovery of conventional products.

Energywood Harvest	Stand Type	Location	Percent of Above Ground Biomass Utilized
None	Plantation	Brewton, AL	51 to 66%
None	Plantation	Iuka, MS	50 to 61%
None	Natural	Lucedale, MS	40%
Preharvest	Plantation	Iuka, MS	75 to 94%
Preharvest	Plantation	Brewton, AL	78 to 86%
Preharvest	Natural	Iuka, MS	75 to 95%
Preharvest	Natural	Lucedale, MS	65%
Integrated	Plantation	Brewton, AL	89 to 91%

Table 2. Energywood harvesting cost loaded in chip van by function.

Type Harvest	Stand Type	Location	Function			
			Fell	Skid	Chip	Total[1]
			$US/Tonne			
Preharvest	Plantation	Brewton, AL	8.24	4.29	3.28	16.09
Preharvest	Plantation	Iuka, MS	4.16	7.36	5.21	16.73
Preharvest	Natural	Iuka, MS	4.16	9.17	3.36	16.69
Preharvest	Natural	Lucedale, MS	5.26	6.23	6.38	17.87
Integrated	Plantation	Brewton, AL	4.25	2.88	4.01	11.14

[1]Includes all woods cost.

Table 3. Cost of harvesting pulpwood and sawlogs as roundwood.

Stand Type	Location	Harvesting Cost		
		Type Energywood Harvest		
		None (Control)	Preharvest	Integrated
		$US/Tonne		
Plantation	Brewton, AL	13.38	8.84	9.08
Natural	Iuka, MS	11.23	10.99	
Natural	Lucedale, MS	8.37	6.19	

Integrated Harvest of Energywood

Integrated harvesting of energywood has been implemented by Scott Paper Company using one of their company crews. Feller-bunchers fell both the energy component and the material to be moved as roundwood in a single pass through the stand. The feller-bunchers perform the sorting as they fell the stems. Notice that the cost of felling the energywood is significantly reduced when the feller-buncher does not need to move around standing trees. (Compare the preharvest felling costs at Brewton, AL, to the integrated felling costs in Table 2.)

The tops of the roundwood were also recovered for energywood during early tests of integrated operations by having the skidder move the roundwood along side the chipper where laborers topped the roundwood with chainsaws. Miller et al. (1987) reported that recovering the roundwood tops made the integrated energywood costs insensitive to the amount of understory available for recovery (see Figure 1). The recovery of roundwood tops for energywood was later abandoned. Chipping of the tops had been facilitated by leaving the top intact along with a portion of the bole which was usable as pulp. This pulp portion of the bole was deemed too valuable to be relegated to energywood.

BENEFITS OF ENERGYWOOD HARVEST

Both systems of energywood harvest accrued benefits to other operations. In most tests, dramatic reductions were observed in the cost of removing the roundwood when removing energywood. Table 3 summarizes the cost comparisons for roundwood operations with and without energywood operations.

A second major benefit of harvesting energywood is the reduction of the cost of preparing the site for re-establishing the stand. Tables 4 and 5 report the results of studies comparing site preparation costs following energywood and roundwood operations with roundwood only operations (Watson, Stokes, and Savelle 1984; Ragan 1988).

In the Brewton, Alabama, tests (Table 4) it was felt that only discing was necessary to re-establish the stand following energywood operations. However, following the conventional roundwood operation, the shear-rake-pile-disc treatment would be necessary to give equivalent results. The shear-rake-pile-disc treatment on the sites with no energywood harvest cost $140 per hectare more than discing the sites where the energywood was removed. In the Iuka, Mississippi, tests (Table 5), the same shear-rake-pile-burn

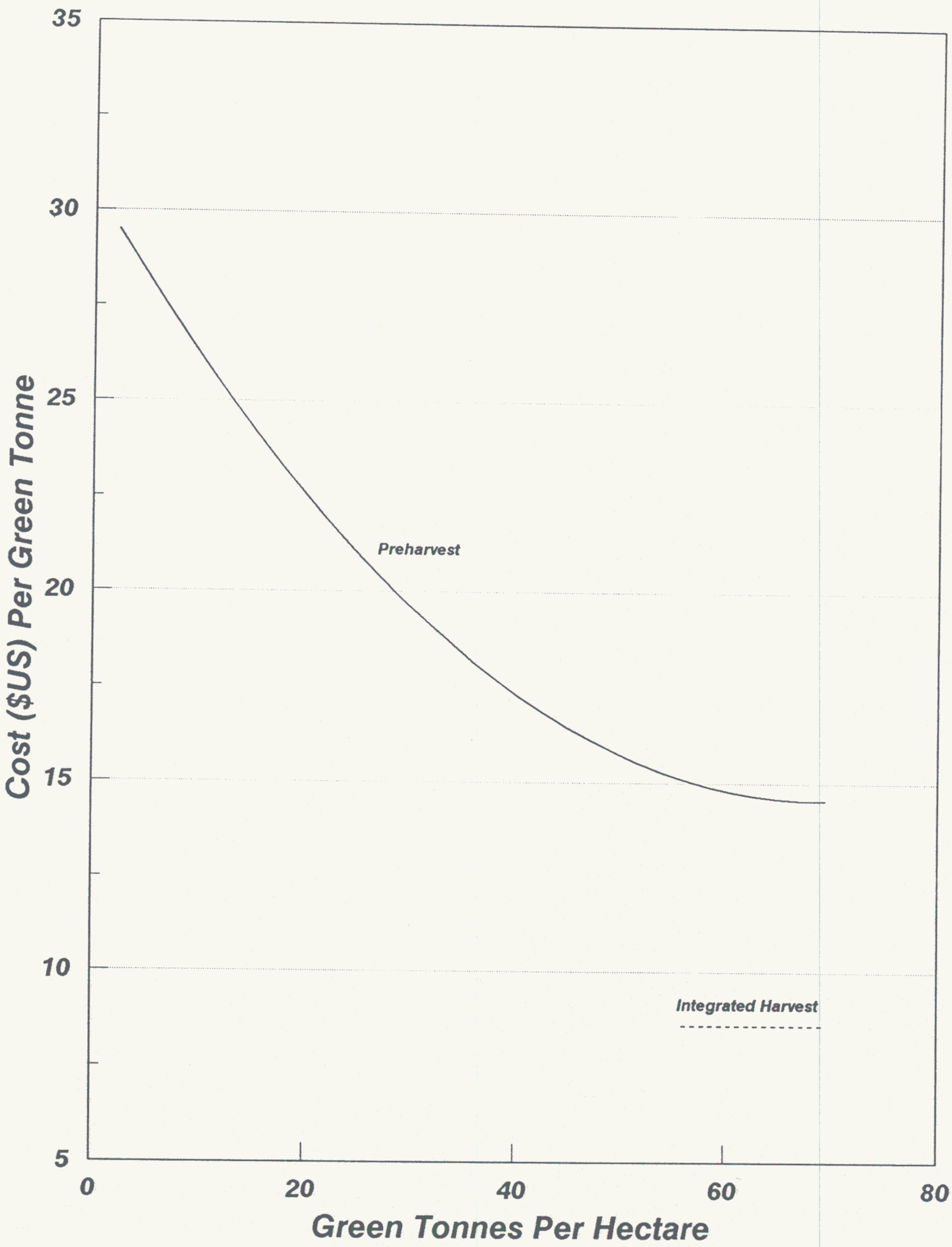

Figure 1. Cost of energywood harvest

Table 4. Site preparation benefits of intensive harvest--Brewton, AL.

Harvest Treatment	Site Preparation Treatment	Cost
	------------$US/Hectare----------	
No Energywood--Conventional-Roundwood	Shear-Rake-Pile-Disc	$236.13
Integrated Energywood and Roundwood	Single Disc	44.92
	Double Disc	92.81
Preharvest Energy-wood--Conventional-Roundwood	Single Disc	47.39
	Double Disc	94.79

treatments were completed on harvested blocks on which the energywood component had been removed and on harvested blocks which received no energywood treatment. Removing the energywood left the blocks so clean that much less time was required to site prepare the area, thus a site preparation savings of at least $60 per hectare could be credited to the energywood operation. However, this intensive site preparation treatment (shear-rake-pile-burn) was not needed following an energywood harvest; only discing the site was necessary. Discing alone could be accomplished on the areas which had also had the energywood removed at a savings of $350 per hectare over areas that had no energywood removed and had a shear-rake-pile-burn site preparation treatment.

DISCUSSION

The removal of small stems as energywood has been shown to be economically feasible, especially when the costs of fossil fuels are high. The present situation, where fossil fuels are relatively inexpensive, has caused some southern U.S.A. firms to abandon the harvest of this energywood. However, the savings on site preparation costs and the roundwood cost savings attributable to energywood harvest have enabled at least one firm to continue these small stem harvesting operations.

Table 5. Regeneration benefits of intensive harvest--Iuka, MS.

Harvest Treatment	Site Preparation Treatment	Site Preparation Cost	Planting Cost	Total Regeneration Cost
		--------$US/Hectare--------		
No Energywood--Conventional-Roundwood	Shear-Rake-Pile-Burn	$365.79	$104.95	$470.24
Preharvest Energywood--Conventional Roundwood	Shear-Rake-Pile-Burn	301.76	104.65	406.41
	Disc	115.13	115.13	230.25

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