Cost Factors in Harvesting and Transporting Woody Biomass

FACT SHEET 4.7

INTRODUCTION

Harvesting and transportation costs for woody biomass in its different forms vary due to tract size, tree species, volumes removed, distance to the wood-using/storage facility, terrain, road condition, and other considerations. There is tremendous variation of these factors within the southern United States, so timber harvesting, transportation, and delivery systems must be designed to meet constraints at the local level. This fact sheet provides a brief explanation of factors affecting costs for harvesting, transporting, and delivering woody biomass. It also summarizes relevant research relating to harvesting costs. Without a real-life situation or example, it is difficult to determine real harvesting costs. As a result, this fact sheet will focus more on cost factors than currently estimated costs.

COSTS OF TIMBER HARVESTING OPERATIONS BY TYPE

Harvesting costs depend on equipment investment, stand size, tree species and volume removed, terrain, and even degree of difficulty due to proximity to houses, power lines, public roads, noise restriction areas, and other restrictions posed by forestry related ordinances. Harvesting costs also depend on the type of equipment used, season in which the operation occurs, and a host of other factors. *Table 1* shows price ranges for pulpwood stumpage and clean chips delivered, averaged across the South from 2000 to 2006 and averaged 2006 fuel chip price ranges.

Conventional Harvesting Costs. Conventional timber harvesting equipment is expensive and can constitute as much as 40 to 50 percent of the delivered cost of wood. Purchase costs, for highly mechanized conventional systems capable of handling the harvest and recovery of woody biomass commonly range from $600,000 to $2,000,000[1]. Added to these expenses are operation and maintenance costs of $120 to $650 per hour and highly variable transportation costs that are determined based on haul distance, fuel prices and other factors[1].

PULPWOOD STUMPAGE (Range of Southeast Averages from 2000–2006)	
	$/Green Ton
Pine	$6.06 – $7.78
Hardwood	$4.14 – $6.98
2006 FUEL CHIPS FOB MILL/WOODS (Range of Southeast Averages)	
	$/Green Ton
Pine Fuel Residue	$14.00 – $20.25
Hardwood Residue	$10.75 – $18.50
CLEAN CHIPS DELIVERED (Range of Southeast Averages from 2000–2006)	
	$/Green Ton
Pine Pulpwood	$20.97 – $24.92
Hardwood Pulpwood	$18.92 – $27.60

* Data in this table is courtesy of Timber Mart-South, Frank W. Norris Foundation, Athens GA.

Table 1. 2000–2006 Price Ranges

Ashton, S.; B. Jackson; R. Schroeder. 2007. Cost Factors in Harvesting Woody Biomass. Pages 153–156.
In: Hubbard, W.; L. Biles; C. Mayfield; S. Ashton (Eds.). 2007. Sustainable Forestry for Bioenergy and Bio-based Products: Trainers Curriculum Notebook. Athens, GA: Southern Forest Research Partnership, Inc.

LOGGING COST ANALYSES WORKSHEETS AND CALCULATORS

WHAT ARE THEY? Logging cost analysis (LCA) worksheets are computerized spreadsheet calculators that provide basic, usable information to determine operating costs for harvesting equipment, systems, and operations. Hourly operating costs, productivity, logging costs, harvesting system costing models, and road construction and maintenance models are available.

WHERE CAN I FIND ONE? A good collection of some easily accessible LCA worksheets can be found at this website: http://www.cnr.vt.edu/harvestingsystems/costing.htm

Transporting conventional timber harvesting equipment is expensive. It generally involves four to eight separate pieces of equipment, all of which need to be transported from site to site. Each piece of equipment requires its own tractor and trailer. Virtually all transportation of raw wood material from the harvesting site the end-user facility is by trucks.

Overcoming these costs typically requires tracts with large volumes of relatively valuable material. At this time and based on current cost and revenue estimates, woody biomass for energy and other bio-based products may not generate enough revenue on its own to be profitable. Recovery of this material depends on its value for other objectives such as reforestation or wildfire fuel reduction or harvesting concurrent with a harvest of traditional forest products. As fossil fuel prices continue to rise, harvesting woody biomass for energy will become profitable in more situations.

Results from a study in south Georgia show that under the right conditions, a small chipper can be added to obtain additional chip production without adversely impacting roundwood production[2]. The market for fuel chips varies with local supply and demand across the South, but delivered prices of $14 to $19 per ton are common (Timber Mart South 2006). Westbrook projects that chips can be produced from limbs and tops of harvested trees at costs ranging from $11 per ton and up. Harvesting understory for use in making fuel chips is about $1 per ton more expensive.

THE FOREST RESIDUES TRANSPORTATION MODEL (FORTS)

WHAT IS IT? It is a computerized spreadsheet calculator designed to help users compare alternative methods of moving woody biomass from the forest to a wood-using facility

WHAT DOES IT DO?

- Estimates loading and hauling costs for different combinations of equipment
- Evaluates the best mix (numbers and types) of equipment
- Compares different hauling routes
- Examines reloading and two-stage hauling opportunities

WHERE CAN I FIND IT? http://www.srs.fs.usda.gov/forestops/biomass.htm

Per ton costs increase as the volume chipped decreases per acre. Westbrook's estimates suggest that if no more than 10 loads of roundwood are produced before a load of chips is made, that chipper-modified system will break even if the market price for fuel chips is $17 per ton. Cost projections suggest that removing only limbs and tops may be marginal in terms of cost since one load of chips was produced for about every 15 loads of roundwood.

Single and Smaller Machine Harvesting Costs. Efforts have been made to investigate newer, smaller timber harvesting technology systems, much of it through the modification of agricultural or industrial machines. Logging systems that employ smaller, single machines with multiple functions will have lower per unit transportation and setup costs. So relocation is more economical. Smaller timber harvesting equipment may also have more advantages because more than one unit may be moved on a transport trailer[3]. Additionally, smaller timber harvesting equipment has lower capital costs. For example, currently a small tractor costs between $15,000 and $40,000, with modifications for forestry averaging between $4,000 and $20,000[1]. While the use of smaller equipment with lower capital costs may allow for optimum performance at lower levels of productivity, it is rarely economically feasible to harvest a lower volume of less valuable material[4]. In addition, smaller, less mechanized machines often may have difficulty meeting OSHA approved safety standards. For more information on small-scale equipment, please see Fact Sheet 4.3.

COST PER GREEN TON
(Assuming an Average Haul Rate of $0.12)

Haul Distance	*$/Green Ton*
45 miles	$5.40
75 miles	$9.00
100 miles	$12.00

Table 2. Transportation Costs

WOODY BIOMASS TRANSPORTATION AND DELIVERY COSTS

Delivery of woody biomass from the harvesting site to a conversion facility, like delivery of more conventional forest products, accounts for a significant portion of the delivered cost[5]. In fact, transportation of wood fiber accounts for about 25 to 50 percent of the total delivered costs and highly depends on fuel prices, haul distance, material moisture content, and vehicle capacity and utilization[6]. Also, beyond a certain distance, transportation becomes the limiting profitability factor and its costs become directly proportional to haul lengths. *Table 2* shows cost per green ton for 30, 60, and 100 miles, assuming an average haul rate of $0.12 per ton per mile. One hundred miles is generally considered a maximum haul distance in forest operations

SUMMARY AND CONCLUSIONS

Currently, the most cost-effective harvesting system for recovering forest residue for biomass is in-woods chipping as part of a conventional logging or thinning operation. Bulk vans, due to their relatively light weight and large capacity, are generally considered to be the most cost-efficient mode of transporting preprocessed woody biomass provided the access roads are suitable for these over-the-highway carriers.

At current prices, timber harvesting contractors are not likely to actively pursue purely biomass-related projects. On private land, timber or biomass sales involve the transfer of ownership of the trees or biomass to be harvested to the contractor either based on a lump-sum price or a stumpage (pay-as-you-cut) rate[1]. The contractor's profit is determined by the difference between what they pay the landowner, the price they get at the mill or plant, and the cost of harvesting and transporting the biomass. Due to low demand and relatively high costs of harvesting and transporting, woody biomass is currently a relatively low valued material. While contractors may not seek out a woody biomass harvesting operation alone, they may agree to harvest biomass along with higher valued material. In addition, they may agree to harvest woody biomass if they are paid on per ton or per hour basis.

ENDNOTES

1 Visser, J.M.; Hull, R.B.; Ashton, S.F. 2006. Mechanical vegetative management. In: Monroe, M.C.; McDonell, L.W.; Hermansen-Baez, L.A. (Eds.). Changing Roles: Wildland-Urban Interface Professional Development Program. Gainesville, FL: University of Florida.

2 Westbrook, M; Green, D; Izlar, R.L. 2006. Harvesting forest biomass by adding a small chipper to a ground-based tree-length Southern pine operation. Center for Forest Business. University of Georgia.

3 Stanturf, J.A.; Kelllison, Broerman, F.S.; Jones, S.B. 2003. Productivity of southern pine plantations: Where are they now and how did we get here? Journal of Forestry. 101(3): 26–31.

4 Updegraff, K; Blinn, C.R. 2000. Applications of small-scale forest harvesting equipment in the United States and Canada (Staff Paper Series No. 143). St. Paul, MN: University of Minnesota, Minnesota Agricultural Experiment Station and College of Natural Resources.

5 Demeter, C.P.; Knowles, D.F.; Olmstead, J.; Jerla, M.; Shah, P. 2003. Assessment of power production at rural utilities using forest thinnings and commercially available biomass power technologies. Landover, MD: Antares Group, Inc.

6 McDonald, T.P.; Taylor, S.; Rummer, R; Valenzuela, J. 2001. Information needs for increasing log transport efficiency. First International Precision Forestry Symposium. Seattle, WA: University of Washington.