WORK IN PROGRESS: MODELING AND ANALYSIS OF SUPPLY SYSTEMS' COST AND ENERGY EFFICIENCY FOR YOUNG DENSE STANDS

The work on modeling harvesting and transport systems for young thinning stands has progressed and some preliminary results based on current models are here presented. Analyses show that the effects of implementing methods and technologies for boom-corridor thinning and production of bundles already in stand give significant reduction of systems' costs, especially for stand with tree sizes below ca 30 dm^3. The work on implementing models for analyzing the effects of load compression and chain-flail delimbing/debarking operations at landing/terminal will continue and then be presented later in 2013.

REQUIREMENTS TO REACH HIGH EFFICIENCY

New, more cost-efficient, techniques and supply chains for small diameter trees must be developed in order to reach the full extractible biomass potentials found in young dense thinning stands in the BA region. The requirements of different plants differ greatly in terms of type of raw material, quality and delivery time (seasonal differences). Thus, there is a need for handling a great variety of products throughout the supply chain. To reach high transport efficiency at long transport distances high payloads are required, i.e. "bulky" materials need to be shifted to "denser" modes.

When storing biomasses, the higher the degree of fractionation and the fresher the material the higher the dry matter losses due to biological and chemical degradation. It is hypothesized that feed stock value at the delivery point will correlate with the freshness of the material. Studies on possible implementation of e.g. prototype bundle harvesters, load- and bunch compression devices, new thinning methods, new cutting technology, comminuting and sorting processes have shown promise to increase work efficiency throughout the supply chain.

Many of the studied techniques in literature are not in use any more, or are not built and tested in practice, or needs to be further developed in order to reach high operational efficiency and reliability. But their potential effect on the total supply chain cost- and energy consumption has however not yet been analyzed when integrated and compared to current conventional supply systems from forest to industry.

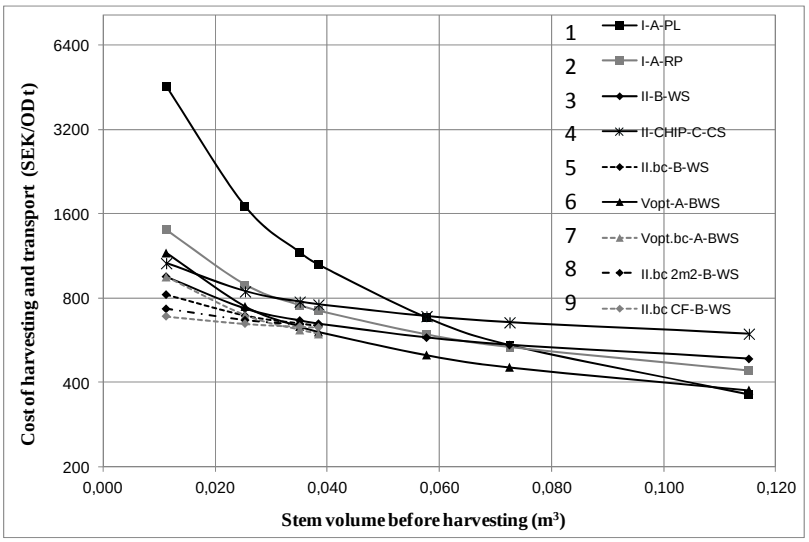
OBJECTIVES & STUDY DESIGN

The objectives are to study the effect of implementation of new harvesting and handling technologies. These include various stands and harvested timber assortments, transportation distances and stand characteristics. The study will concentrate on the supply chain cost- and energy efficiency for biomass extraction from early thinning to industry and compare it with the conventional systems in use. So far has 13 different supply systems been modeled and analyzed. The cost of each supply system at different transport distances was calculated as the sum of roadside harvesting costs, landing operation costs and road transportation costs.

SOME PRELIMINARY RESULTS

The results for 9 systems based on conventional and new technologies are shown in the table and figure below and are given for forwarding and trucking distances of 300 m and 75 km, respectively. The conventional supply system for pulpwood gives the highest cost for tree sizes below some 60 dm^3 and it very sensitive to harvested tree sizes. The system breaks even at a tree size of some 70 dm^3 to conventional system for rough delimbed stems. The conventional system for delivering chips give highest cost for tree sizes over 60 m^3. The effects of implementing boom-corridor thinning methods and techniques and bundle-harvesters significantly reduces the cost in stands were the average tree size is below ca. 30 dm^3.

System		Description
1	I-A-PL	Conv. pulpwood system
2	I-A-RP	Conv. Rough delimbed pulpwood system
3	II-B-WS	Conv. Fuel wood system for tree parts
4	II-CHIP-C-CS	Conv. Fuel wood system for chips
5	II.bc-B-WS	Conv. Fuel wood system for tree parts using boom-corridor thinning
6	Vopt-A-BWS	Fuel wood system for tree parts with a bundle-harvester
7	Vopt.bc-A-BWS	Fuel wood system for tree parts with a bundle-harvester using boom-corridor thinning
8	II.bc 2m2-B-WS	Fuel wood system for tree parts using improved boom-corridor thinning technology
9	II. bc CF-B-WS	Fuel wood system for tree parts using new boom-corridor thinning technology



[NOTE: y axis is given in Log_2 scale.]

Results from the complete analyses including the effects of implementing e.g. load compression and chain flail delimbing/debarking products and operations at landing and terminals on the supply chains cost and energy requirements will be presented later 2013.

KEYWORDS: Fuel wood, operational efficiency, small diameter trees, systems analyses

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