

## 42. EXTRACTING AND CHIPPING HARDWOOD CROWNS FOR ENERGY

**Kjell Suadicani<sup>1\*</sup> and Bruce Talbot<sup>2</sup>**

<sup>1</sup> Forest and Landscape Denmark, University of Copenhagen, Denmark

<sup>2</sup> Norway Forest and Landscape Institute, Ås, Norway

\* kjs@life.ku.dk

### Introduction

We studied the feasibility of extracting and chipping hardwood crowns for energy after motor-manual thinning in stands of common beech. Large crowns were extracted and chipped from stands where only sawlogs had been produced (treatment 2), while small crowns were extracted and chipped from stands where sawlogs and firewood had been harvested (treatment 1). Four product-mix alternatives were considered (figure 1).

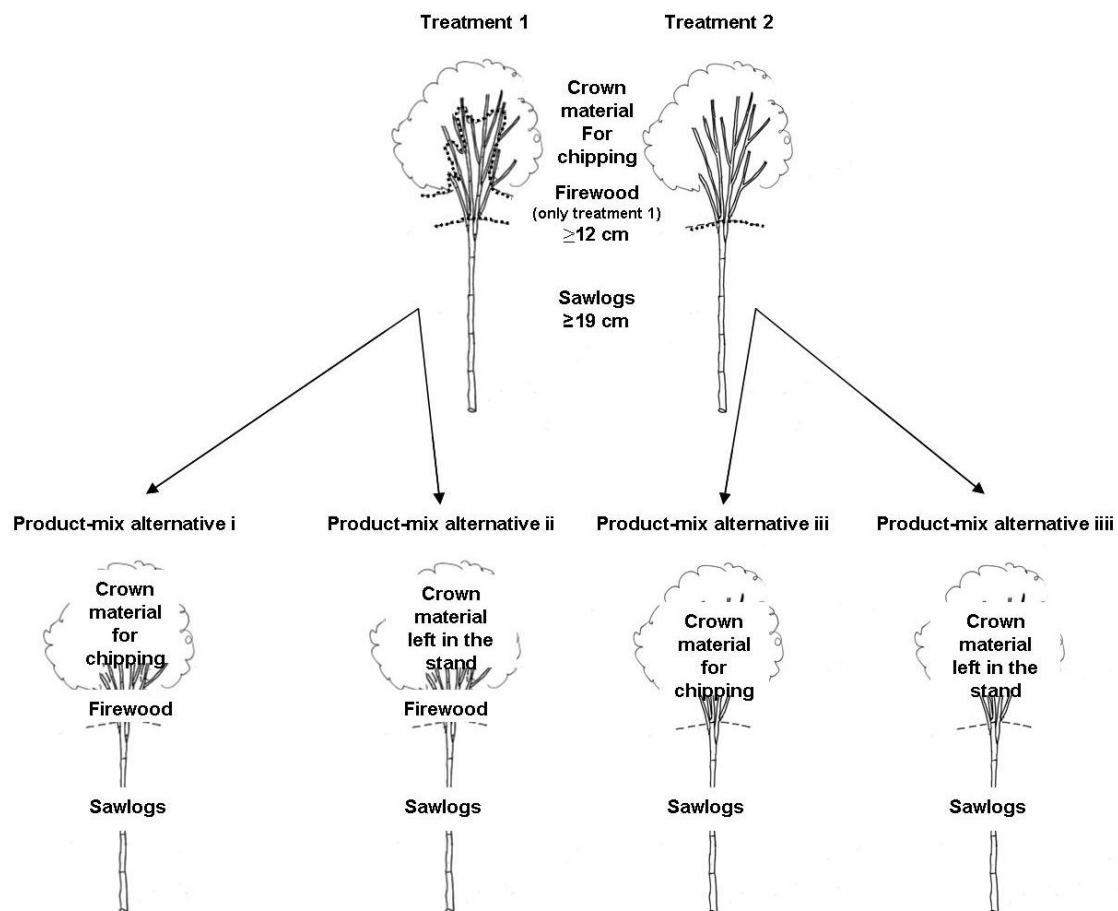


Figure 1. The two treatments and the four product-mix alternatives.

### Results

The fuel chip yield was  $15 \text{ m}^3_{\text{solid}}$  per ha when extracting and chipping large crowns while it was  $8 \text{ m}^3_{\text{solid}}$  per ha when extracting and chipping small crowns. The productivity for extracting and chipping large crowns was  $8.5 \text{ m}^3_{\text{solid}}$  per work place hour and  $5.9 \text{ m}^3_{\text{solid}}$  per work place hour when extracting and chipping small crowns. There was no significant difference in the productivity for forwarding sawlogs or sawlogs and firewood. Extracting and chipping large crowns gave a net income of 167 € per ha (11 € per  $\text{m}^3_{\text{solid}}$ ), while extracting and chipping small crowns gave a lower net income of 23 € per ha (3 € per  $\text{m}^3_{\text{solid}}$ ). In table 1 it can be seen, that the total economic output for product mix alternative I, ii and iii are quite similar.

Table 1. Total economic output from the four product-mix alternatives.

Treatment		1 (small crowns)		2 (large crowns)	
Product-mix alternative		(i)	(ii)	(iii)	(iv)
Production of chips		YES	NO	YES	NO
<b>Income</b>					
Sawlogs	€ per ha	1205	1205	1205	1205
Firewood	€ per ha	322	322	0	0
Fuel chips	€ per ha	236	0	450	0
Total Income	€ per ha	1762	1527	1655	1205
<b>Costs</b>					
Harvesting	€ per ha	211	211	122	122
Forwarding sawlogs	€ per ha	196	196	196	196
Forwarding firewood	€ per ha	64	64		
Extracting and chipping of tops	€ per ha	213		283	
<b>Total Cost</b>	€ per ha	684	471	600	317
<b>Net income</b>	<b>€ per ha</b>	<b>1079</b>	<b>1056</b>	<b>1055</b>	<b>887</b>

### Discussion

Because the difference in economic outcomes is small between the three product-mix alternatives (i), (ii), and (iii), the rational choice would be to produce only two assortments in each stand, either product-mix alternative (ii) (sawlogs and firewood billets), or product-mix alternative (iii) (sawlogs and fuel chips).

In stands where firewood billets are produced, the minimum top diameter can possibly be reduced, and the utilised volume could thereby be increased. Firewood billets should be the product of choice in stands of poorer quality, as a larger proportion of the harvested volume would not meet sawlog specifications but would meet the size requirements for firewood. An increased firewood fraction in the product-mix would make a larger economic contribution than an increased chip fraction.

Fuel chips should preferably be done in stands with large crown residues. The stands should also be of some size minimising the relocation costs.

The study showed that extracting and chipping large hardwood crowns is feasible and can make a substantial contribution to woody biomass feedstocks.

**Keywords:** *Bioenergy, chipping, firewood, forwarding, fuel-chips, hardwood.*

### References

Suadicani, K. & Talbot, B. 2010. Extracting and chipping hardwood crowns for energy. *Scandinavian Journal of Forest Research* 25(5):455-461