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Effects of subsidies on the profitability of energy wood production of wood chips from early thinnings in Finland

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ABSTRACT

To increase the production of wood chips for energy from small-diameter ($d_{1.3}$<10 cm) stems in thinnings from young forest stands, Finland's Ministry of Agriculture and Forestry provides financial incentives for the production of wood chips through the Sustainable Silviculture Foundation Law (Kemera). As of Autumn 2010, the Kemera incentive system provides subsidies for wood chips derived from small-sized stems of young stands, 16–19 €/m^3 (8.0–9.5 €/MWh) maximum in typical harvesting conditions (average stem size of removal 30–60 dm^3, and whole-tree chip removal 40–70 m^3/ha).

Total production costs of small-diameter thinning of wood chips with and without the Kemera subsidies were researched. The effects of the Kemera incentives on the profitability of whole-tree chip production were presented and discussed. Results gave a clear indication that wood chips from small-diameter stems cannot currently be produced without the Kemera subsidies from young stands with typical harvesting conditions at the current price level of small-diameter wood chips (17–18 €/MWh). If operating without the Kemera subsidies at a higher price level of small-diameter wood chips, such as 20 €/MWh, the average stem size of whole trees harvested must be greater than 60–70 dm^3 with short road transportation distances between 20 and 40 km to be economically profitable in Finland.

1. Introduction

In Finland, 6.1 million m^3 (12 TWh) of forest chips were used in 2009 (Ylitalo, 2010). Of this amount, 89% was used by energy plants (i.e. heating and power plants) and the remaining portion by small-sized dwellings (i.e. farms, detached and terraced houses) (Ylitalo, 2010). Less than one third, or 1.6 million m^3 (3 TWh) of the total amount of commercial forest chips used for energy generation was produced from small-sized trees in young stands (Ylitalo, 2010).

When harvesting small-sized thinning wood for energy in young stands, the stem size harvested typically has a breast height diameter ($d_{1.3}$) of less than 10 cm, with the stems being harvested as either whole trees (stems with branches) or delimbed stemwood (stems without branches). In Finland, typical harvesting conditions in early thinnings may be described as where whole-tree chip removal is approximately 40–70 m^3/ha with the average stem size of removals in stands ranging between 30 and 60 dm^3 (cf. Kärhä, 2006; Kärhä et al., 2006; Laitila, 2008).

It has been estimated that the stock of both economic and technically harvestable (techno-economical) small-sized thinning wood in young stands is between 3 and 5 million m^3 (6–10 TWh) annually (Hakkila, 2004; Leino et al., 2007; Ranta et al., 2007; Kärhä et al., 2010a). In Finland, the annual use of forest chips for energy generation is to be increased 16–24 TWh (8–12 million m^3) by 2015 and 25 TWh (13.5 million m^3) by 2020 (Anon, 2008a; Pekkarinen, 2010). These goals presuppose that the harvesting volume of small-sized thinning wood is doubled, or even tripled from the current harvesting volume.

However, in attaining the projected harvesting volumes of small-sized thinning wood, a number of problematic factors will need to be addressed, which limit the harvesting of small-sized thinning wood. High harvesting costs, particularly cutting costs, are the primary problems in early thinnings. Small stem sizes, low removals per hectare, dense undergrowth and difficult terrain on the harvesting site all result in low productivity and high cutting costs (Kärhä et al., 2005; Kärhä, 2006, 2007a; Laitila, 2008; Oikari et al., 2010).

Between 2009 and 2010, the mean price of forest chips paid at the gate of energy plants has varied between 16.5 and 19.7 €/MWh in Finland (Anon, 2010a). However, when producing whole-tree chips from young stands, the total production costs are approximately 20–25 €/MWh (Laitila, 2008; Kärhä et al., 2009). In order to increase the production of small-sized wood chips in young stands, the Finnish government provides production subsidies for wood chips of small-diameter stems from early thinnings, according to the Sustainable Silviculture Foundation Law (Kemera) (Anon, 2007).

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Several studies have found that, as a whole system, the profitability of production of small-diameter thinning wood chips from young stands is minimal without the Kemera subsidies (Kärhä, 2002; Vasara, 2006; Helynen et al., 2007). However, there have yet to be cost calculations in which profitability limits are displayed when using the production of small-sized wood chips from early thinnings without the Kemera subsidies.

At the moment, a reorganization of current incentives allocated towards energy wood production and silvicultural practices in young stands is taking place, which will likely lower levels of available subsidies. Ongoing governmental policy discussions will shape the future of the incentives and likely the process of how they are administered.

We undertook a study on the total production costs of small-sized thinning wood chips with and without the Kemera subsidies. This article will introduce the current Kemera subsidy system for energy wood harvesting in early thinnings in Finland, present the effects of the Kemera subsidies on the profitability of whole-tree chip production, and discuss the ramifications of decreasing current Kemera subsidy levels in the future.

2. Kemera subsidy system

2.1. Structure of subsidy system

Current production subsidies offered through the Sustainable Silviculture Foundation Law (Kemera) provide roughly € 20 million of annual incentives for operations pertaining to the production of wood chips for energy generation (Anon., 2010b). Currently (Autumn 2010) there are four subsidy instruments offered for young forest stands in the Kemera incentive system:

I. Subsidy for thinning young stands,
II. Subsidy for small-sized energy wood harvesting,
III. Subsidy for chipping, and
IV. Subsidy for providing work clarification (Anon, 2008b).

The Kemera subsidy is provided only for young forest stands owned by non-industrial private forest (NIPF) owners in Finland (Anon, 2007, 2008b). The subsidy is paid for work by NIPF owners, as well as for contracted work. To be eligible for the subsidy, the area of the stand used when applying the subsidies must be greater than 1 ha (Anon, 2007, 2008b). A principal element in the Kemera incentive system is that any financial support provided is restricted to be given only once throughout a stands rotation cycle (Anon, 2007, 2008b).

2.1.1. Subsidy for thinning young stands

The subsidies for thinning in young forest stands may be separated into three generalized zones: 1, 2, and 3. Zone 1 corresponds to Southern Finland; Zone 2 Central Finland; and Zone 3 Northern Finland. Instruments used to distribute subsidies remain the same in each zone; however, subsidy levels are varied between the different zones when using subsidy instrument I, which is the subsidy for thinning in a young stand. Regional zones corresponding to the levels of financial support are represented by Fig. 1 and Table 1.

For financial support, the recipient must be a NIPF owner, financial support must be paid for thinning operations of the stands second development class, where there is no immediate need for industrial roundwood harvesting, such as a first thinning, after a thinning operation, and the subsidy is not paid for a pre-commercial thinning operation in a first thinning. If the forest owner has no valid forestry plan, the support provided will be lowered by 10%. Operations must meet certain requirements to be applicable for the subsidy for thinning in young stands, such as:

- Removal of trees at stump diameter (d_0) greater than 4 cm must be over 1000 trees per hectare.
- The average $d_{1.3}$ of remaining trees has to be less than 16 cm after thinning operations.
- After the thinning operation, the height of dominate trees cannot exceed 14 m in Scots pine (*Pinus sylvestris* L.) and Norway spruce (*Picea abies* (L.) Karst.) dominated stands, and no more than 15 m in broadleaf stands. If wood is used for energy generation, the height may be increased.
- The density of remaining production trees must be 700–1400 trees/ha according to tree species after a thinning operation. If the initial stand is dense and there is a risk of damaging remaining trees, the density of remaining trees may be 2000 trees/ha maximum.

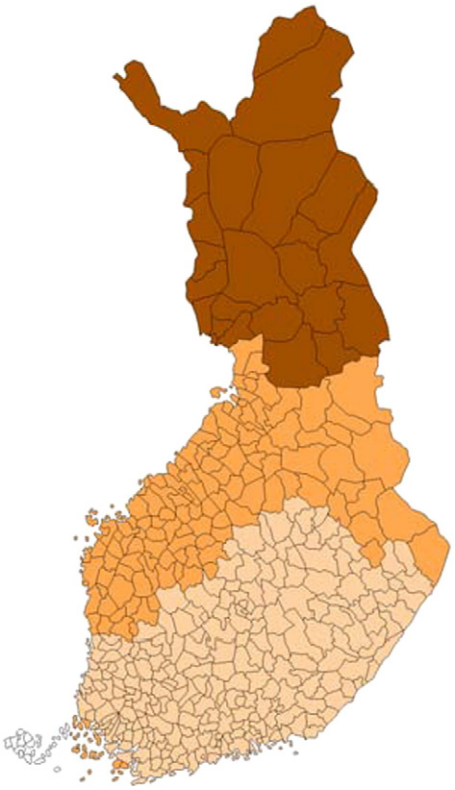

Fig. 1. The Kemera subsidy zones 1–3 (1: Southern Finland … 3: Northern Finland) in Finland (Anon, 2008b). © Affecto Finland Oy, L7507/08.

2.1.2. Subsidy for small-sized energy wood harvesting

In order to be eligible for the subsidy for small-sized wood harvesting to be used in energy generation, again the recipient must be a NIPF owner. Requirements include: Harvested wood must come from the thinning of young stands, energy wood removal is greater than 20 m^3, and the wood must be used for energy generation. Total available subsidies are divided between bunching operations (3.5 €/m^3) and forest haulage (3.5 €/m^3) for a combined total of 7 €/m^3.

Table 1
The levels of subsidies for thinning young stands by the Kemera subsidy zones (see Fig. 1) and party completing the work (Anon, 2008b).

	Subsidy zone		
	1	2	3
	Subsidy, €/ha		
Forest owner conducts own work	135	162	189
Work is conducted by paid labor	210.5	252.6	294.7