POTENTIAL AND DISTRIBUTION OF LOGGING RESIDUES FROM FINAL FELLINGS IN FINLAND

The residual crown and stem biomass left at clear-cut sites offer a possible source of raw material for biorefining. This residue consists of small-diameter stem wood from tree tops and delimbed branches with needles or leaves. Logging residues can be considered as a heterogeneous raw material in terms of chemical and physical properties. Currently, high harvesting costs necessitate a high hectare-based yield for logging residues. Therefore, mostly spruce logging residues have been harvested for energy production due to the relatively large crown biomass of spruce. Unused potential of logging residues of all tree species is still significant, but it is unevenly distributed nationwide.

TREE TOPS AND DELIMBED BRANCHES

Tree tops smaller in diameter than roundwood form a smaller part of the total quantity of logging residue in a site of final felling. Majority of the residual biomass consists of living and dead branches and needles or leaves. The proportions of each of these biomass components depend on the dominant tree species and also on the size of the harvested trees, which determines the stem/crown-ratio, branch thickness etc. Spruce dominated stands are considered the best sites for logging residue removal due to high yield – for instance Scots pine dominated stands produce ca. half of the harvestable crown biomass of spruce dominated stands.

Similar to stumps, the quantity of logging residues is tied to the amount of final fellings. Harvesting levels fluctuate considerably in time – between years 2002–2011 harvestings of saw-timber varied within 17–28 million m^3 – hence the potential of harvestable logging residues vary accordingly. The volumes of harvestable logging residues of pine, spruce and broadleaf species (mainly birches) have been estimated for the whole country on the basis of harvested roundwood volumes using expansion factors and tree species distribution information on a municipal level. Furthermore, the ecological restrictions limiting the volume of harvestable logging residues have been considered. E.g. in the potential calculations, recovery rate of residues from a felling site was set to 70 % as is recommended in the current harvesting guidelines.

Estimated from the average harvesting level of a ten year period from 2002 to 2011, the total logging residue potential was 9.2 million m^3 in the whole country. Norway spruce formed 5.6 million m^3 of the total potential, Scots pine 2.4 million m^3 and broadleaf species 1.2 million m^3. Respectively, based on the harvesting suggestions for final fellings in the national forest inventory data (10th NFI), the maximum harvestable logging residue potential was 11.1 million m^3: 6.9 million m^3 of spruce logging residue, 2.8 million m^3 of pine and 1.4 million m^3 of broadleaf species.

CURRENT UTILIZATION

Logging residues are currently only used in energy production. In 2011, 3.7 million m^3 of logging residues were chipped and burned for energy in Finland. Almost all of this volume consists of spruce residues, so the remaining free potential of spruce logging residues is reduced to 2.4 million m^3 with the average harvesting level (2002-2011) and respectively pine residues to 2.1 million m^3. Broadleaf residues are currently not utilized at all, so all of the broadleaf potential is technically available. Despite the current utilization in energy production, the full potential of logging residues (and other biomass components as well) is naturally open to competition and if more productive or profitable applications are found, the biomass volumes from energy production could be reallocated.

GEOGRAPHICAL DISTRIBUTION

Based on the average harvesting levels of 2002-2011, spruce and broadleaf logging residues are most abundant in Southern and Eastern Finland. In addition to these areas, pine residues are also focused in the Western parts of the country. Based on the NFI data estimation, the maximum logging residue potential of all species is concentrated in the Western coastal areas and in the Eastern and Southern parts of the country.

If the current utilization is extracted from the residue potential based on the average harvesting levels, the remaining unused potential of pine residue is concentrated in Southeastern part of Finland. Similarly, the "free" potential of spruce residue is concentrated in Southern and Eastern parts of the country, whereas in parts of Western Finland both pine and spruce residue potentials are currently in full use on the basis of the average harvesting levels

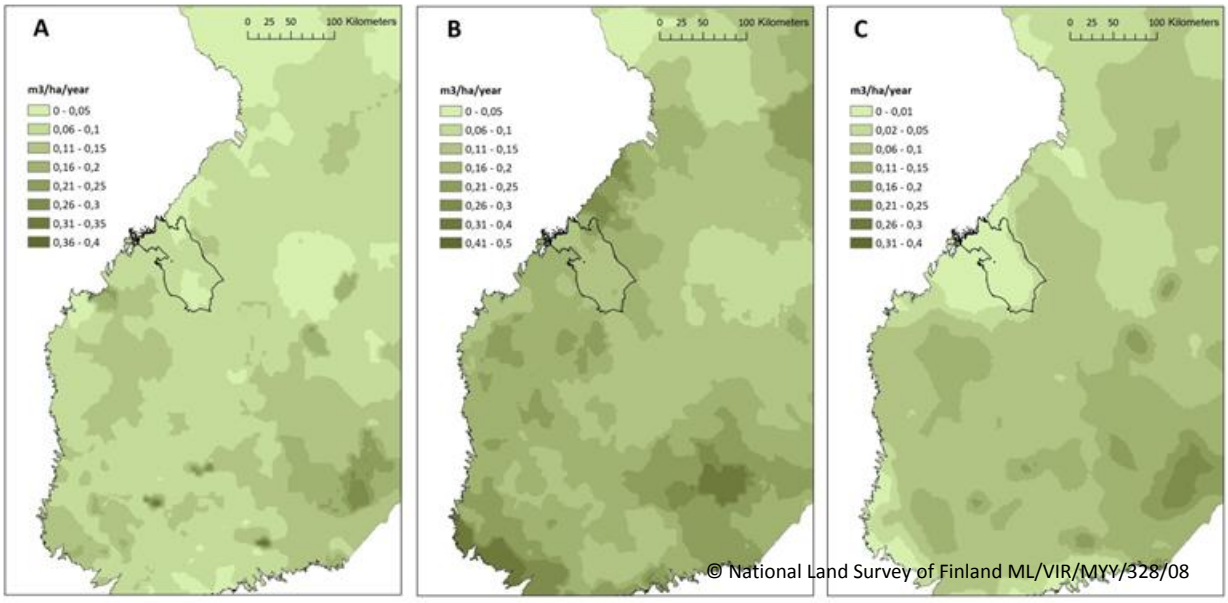

Figure 1. [A]: Volume (per hectare of forest land) of harvestable Scots pine logging residue on the basis of the average harvesting level of 2002-2011; [B]: Technical harvesting potential of pine logging residue as estimated on the basis of 10th NFI; [C]: Potential of pine logging residue when the current utilization of logging residue is extracted from the average harvestable volumes in [A]. Total pine logging residue volumes in the province of Central Osthrobotnia (outlined in the maps): 29 900 m^3 in [A], 50 500 m^3 in [B] and 0 m^3 in [C]. Harvesting statistics [A]: Metla/MetINFO. The geographical distribution of logging residue utilization was estimated by Anttila et al. (2013).

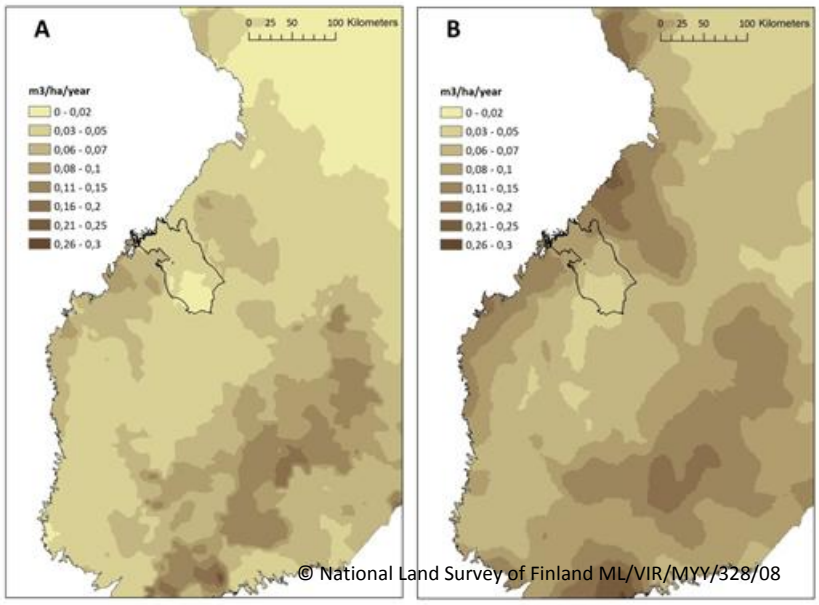

Figure 2. [A]: Volume (per hectare of forest land) of harvestable broadleaf (mainly birch) logging residue on the basis of the average harvesting level of 2002-2011; [B]: Technical harvesting potential of broadleaf logging residue as estimated on the basis of 10th NFI; Total broadleaf logging residue volumes in the province of Central Osthrobotnia (outlined in the maps): 11 500 m3 in [A] and 20 600 m3 in [B]. Harvesting statistics [A]: Metla/MetINFO

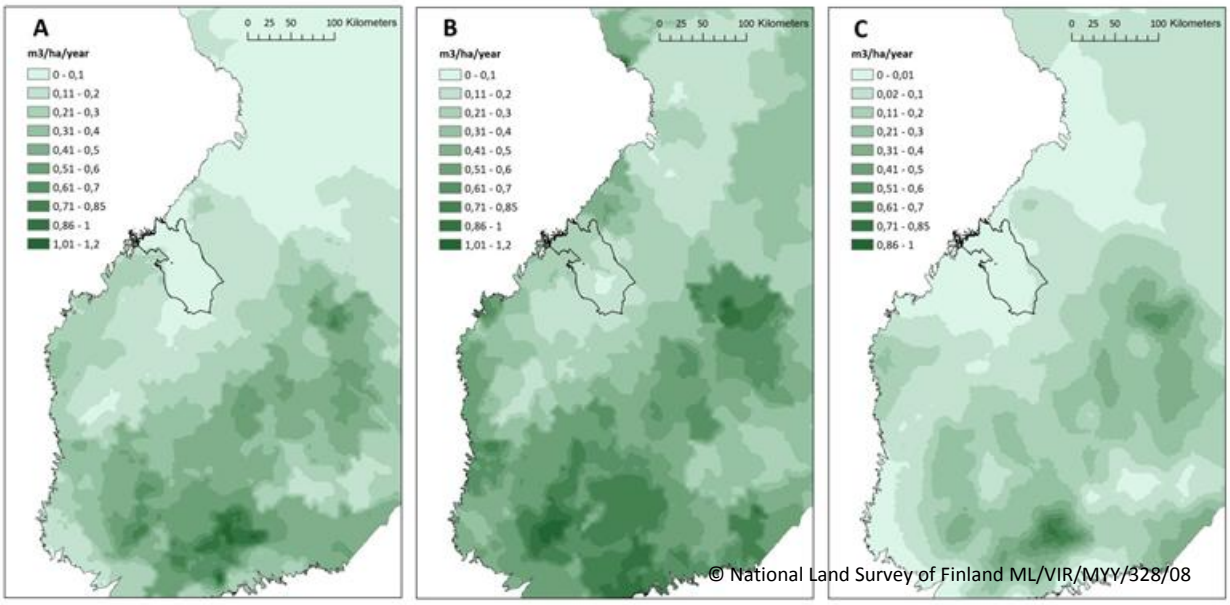

Figure 3. [A]: Volume (per hectare of forest land) of harvestable Norway spruce logging residue on the basis of the average harvesting level of 2002-2011; [B]: Technical harvesting potential of spruce logging residue as estimated on the basis of 10th NFI; [C]: Potential of spruce logging residue when the current utilization of logging residue is extracted from the average harvestable volumes in [A]. Total spruce logging residue volumes in the province of Central Osthrobotnia (outlined in the maps): 31 200 m3 in [A], 57 750 m3 in [B] and 0 m3 in [C]. Harvesting statistics [A]: Metla/MetINFO. The geographical distribution of logging residue utilization was estimated by Anttila et al. (2013).

LITERATURE

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