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Stump and Root Potentials and Geographical Distribution in the Finnish Side of Botnia-Atlantica Region

In In this project we have developed a method by which it is possible to calculate estimates of outcomes for different biomass assortments in the Botnia-Atlantica region. In Finland we used MS-NFI data and data from MELA calculations to find out the most potential areas for stump and root outcomes of different tree species. Results showed that there are differences in different areas when it comes to the potential stumps and roots outcome levels. Also differences in outcomes between regeneration fellings and thinnings are remarkable in certain areas.

INTRODUCTION

Data from the National Forest Inventory (NFI)

In Finland the information about nationwide forest resources is produced through the National Forest Inventory (NFI) that is developed and run by Natural Resources Institute Finland (LUKE). The aim of the NFI at the moment is to produce information about forest resources, land use and ownership structure, logging possibilities, forest health, silvicultural status and indicators of biodiversity (Korhonen et al. 2013).

This information is based on extensive field measurements and statistical and computational methods. In the latest forest inventory in Finland (NFI10) field measurements have been done from nearly 68 000 sample plots. Development and changes in forest resources are considered by comparing the current status of forest resources to the results of earlier inventories.

In the NFI the calculations and statistics are made to large areas, e.g. to forest centers or to national level. To get results also to smaller geographical areas a method which utilizes sample plot data, remote sensing data and other data sources is developed (Mäkisara et al. 2016).

This multi-source National Forest Inventory method (MS-NFI) produces areal covering data sets in 16 meters x 16 meters spatial resolution (cell size) for over 40 different themes. Themes describe different biomass assortments e.g. stem and bark, branches, roots, stumps, needles and leaves separated from pine, spruce, birch and other broadleaved and also include information about growing stock and site properties.

Calculating future development of the forests

Whereas the NFI and the MS-NFI produces information about the existing forest resources, the MELA forest management planning system is used to produce information also about the future development of forests. With the MELA system it is possible e.g. to calculate different wood production scenarios and consider their effects over the planning period on forest growth, development of the growing stock and different kind of harvest removals from the forest (Hirvelä et al. 2017) (Figures 1 and 2).

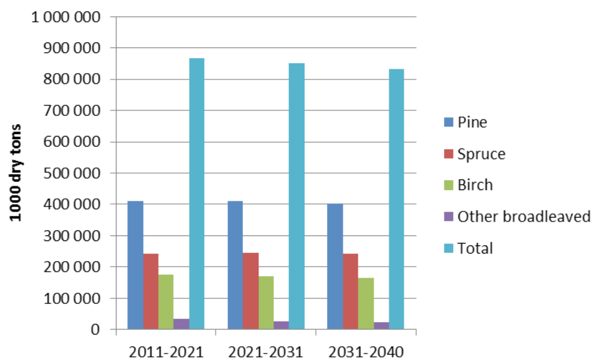

Figure 1. Biomass of living stemwood (1000 dry tons) in Finland and the development according the maximum sustainable harvesting level.

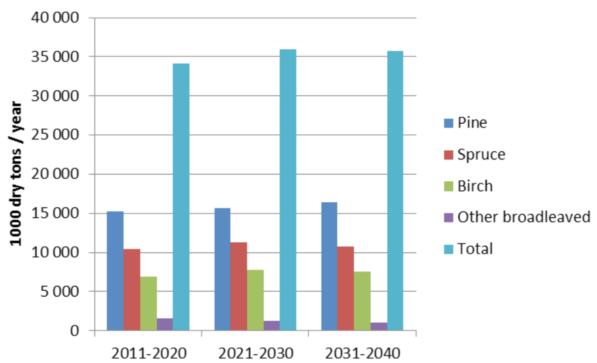

Figure 2. Stemwood removals (1000 dry tons / year) in Finland and the development according the maximum sustainable harvesting level.

The method described in this paper combines the results calculated with the aid of the MELA system with the forest resource information of the MS-NFI. It gives predictions of the amounts of different biomass assortments according to certain logging schedule. Results about biomass assortments are calculated to 8 km x 8 km grid.

NEW METHOD FOR UPDATING THE BIOMASS ASSORTMENT DATA

In this study a new method is developed for updating the biomass assortment data. The method is programmed to ArcGis geographical information system. The basic idea behind the method is to use the MELA calculations to make a forest management schedule to the Finnish side of the Botnia-Atlantica area and to use The Multi-source National Forest Inventory Raster Maps of 2015 (©Natural Resources Institute Finland, 2017) to distribute and refine those results to a grid of a certain cell size.

As a first step, we made forest management programmes for our study area which consists of the two forest centers located in the BA-region (E-P, RaP) and of the four surrounding forest centers (P-P, K-S, Pir, L-S) (Figure 3). Forest management programmes are made by MelaTupa –web application (http://mela2.metla.fi/mela/tupa/index.php). In the logging schedules made by MelaTupa the objective was to maximize sustainable roundwood and energy wood yield.

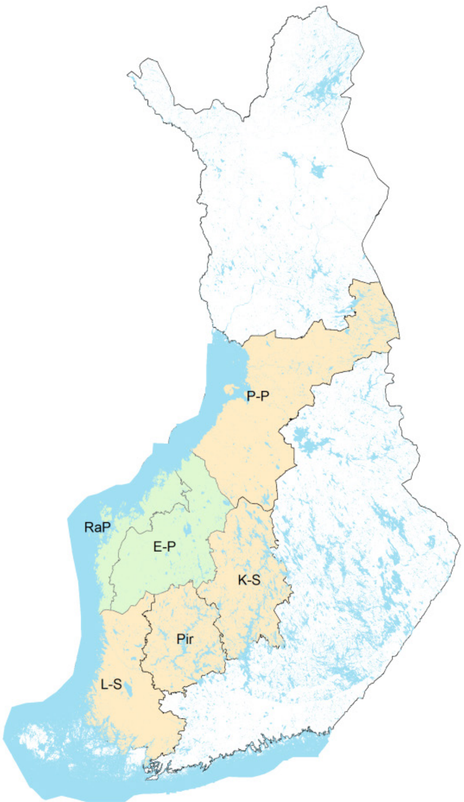

Figure 3. Botnia-Atlantica area in Finland and the surrounding forest centers (P-P = Pohjois-Pohjanmaa, RaP = Rannikko Pohjanmaa, E-P = Etelä-Pohjanmaa, K-S = Keski-Suomi, Pir = Pirkanmaa, L-S = Länsi-Suomi).

As a second step we used the information about the outcomes of different biomass assortment from each forest center, as an input data in our calculation method. In the calculation phase, we distributed the biomass assortment information to 8 km x 8 km grid cells by aid of the MS-NFI data and rules for regeneration fellings and forest thinnings. As a result, we got the updated forest biomass data as areal covering rasters – five forest biomass assortments for each of the three tree species.

Our calculation method is programmed as scripts by Python language which enables easy repetition of the calculations when needed and also helps the documentation of calculation details and used parameters.

RESULTS

Results during the period 2011-2010 are calculated both to the forest centers (in tables) and to 8 km x 8 km raster surfaces (in figures). At the forest center level dry biomass estimates are produced for the whole area of each forest center and also as an average per hectare and per year outcome of wood production forest land. In the raster surface format dry biomass estimates are calculated to the area of every grid cell and presented in figures as an average dry biomass amount per hectare and per year. Both in raster and forest center results different kind of areas which are not usable for wood production (e.g. conservation areas) are not included in the calculations.

Spruce stumps and roots

Our results show that the most potential areas for lifting Norway spruce stumps and roots are located in the southeast part of the study area (Figure 4). Keski-Suomi (K-S) and Pirkanmaa (Pir) forest centers have the biggest potential of the total biomass of spruce stumps and roots (Table 1). Pir forest center has also the highest hectare wise average potential whereas Pohjois-Pohjanmaa (P-P) has the lowest. Inside the Botnia-Atlantica region, areas in the southwest part of the region have bigger potential of spruce stumps and roots than the other parts (Figure 4).

Inside the forest centers there are some differences in the biomass potentials, when it comes to the geographical distribution of spruce stumps and roots (Figure 4). In P-P forest center the northeast and the south part of the forest area have bigger potentials than the middle area. In Rannikko-Pohjanmaa (RaP) forest center the south part of the area has more potential for stumps and roots lifting than the other parts. Also Länsi-Suomi (L-S) forest center has both areas with very high and low potential for stump and root lifting (Figure 4).

Pine stumps and roots

According to our results, pine stump and roots potential is rather equally distributed among forest centers, though the middle areas of P-P forest center has an area with lower potential than elsewhere (Figure 5). Biggest continuous areas with good potentials for pine stump and root lifting can be found from the middle part of

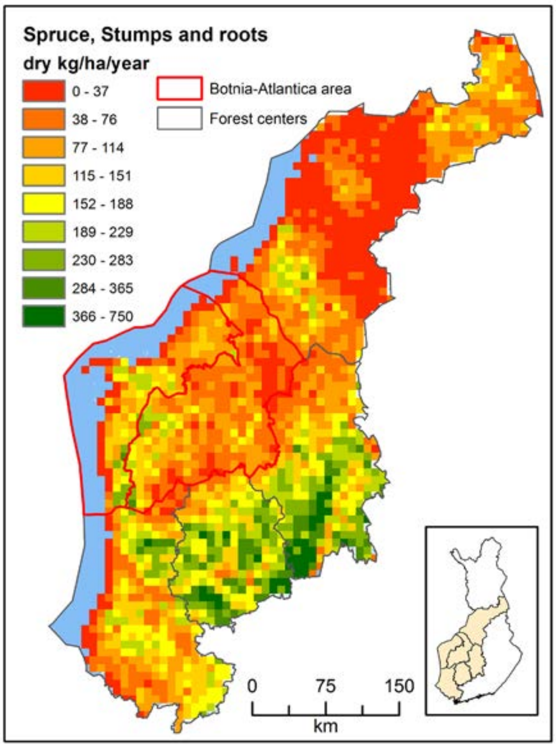

Figure 4. Potential outcome of spruce stumps and roots biomass from loggings and its geographical distribution, dry mass kg/ha/year.

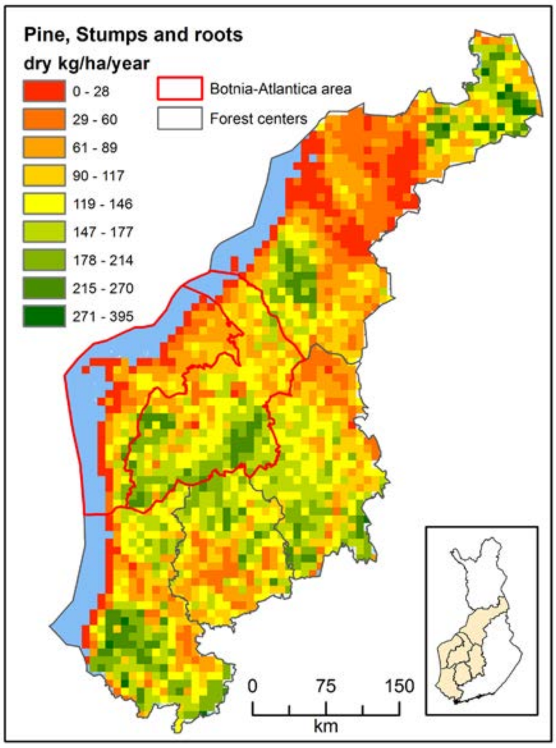

Figure 5. Potential outcome of pine stumps and roots biomass from loggings and its geographical distribution, dry mass kg/ha/year.

the study area (Figure 5). When it comes to the total potential of pine stumps and roots, P-P forest center has clearly the biggest potential whereas RaP and Pir have the lowest ones (Table 1).

In the case of average hectare wise biomass potentials of pine stumps and roots, L-S and Etelä-Pohjanmaa (E-P) forest centers have the highest amounts and in this case P-P and RaP have the lowest amounts (Table 1).

In the Botnia-Atlantica area, the E-P forest center has much more potential than RaP when it comes to the total potentials of pine stumps and roots. In hectare wise results there is not a big difference between these two forest centers (Table 1).

Broadleaved trees' stumps and roots

In broadleaved category the most important tree species is birch. The amounts and utilization of other broadleaved tree species are much smaller. Highest potentials of broadleaves' stumps and roots can be found in the south part of Pohjois-Pohjanmaa province and from the southeast part of the study area (Figure 6).

The best areas when it comes to the total biomass potential of broadleaves' stumps and roots are P-P and K-S forest centers (Table 1). Pir, RaP and L-S forest centers come up when considering the hectare wise average amounts of broadleaves' stump and root biomass. In the Botnia-Atlantica area, the total potential of broadleaves stumps and roots is bigger in the E-P than in the RaP forest center, but in the case of average hectare wise potential the situation is just the opposite (Table 1, Figure 6).

There are also differences in geographical distribution of potential outcomes of broadleaves stumps and roots inside the forest centers. In Pir and K-S forest centers the south parts of the area have more potential for broadleaves stump and root lifting than the north parts of the centers. In the P-P forest center the middle part of that area has less potential than the other area (Figure 6).

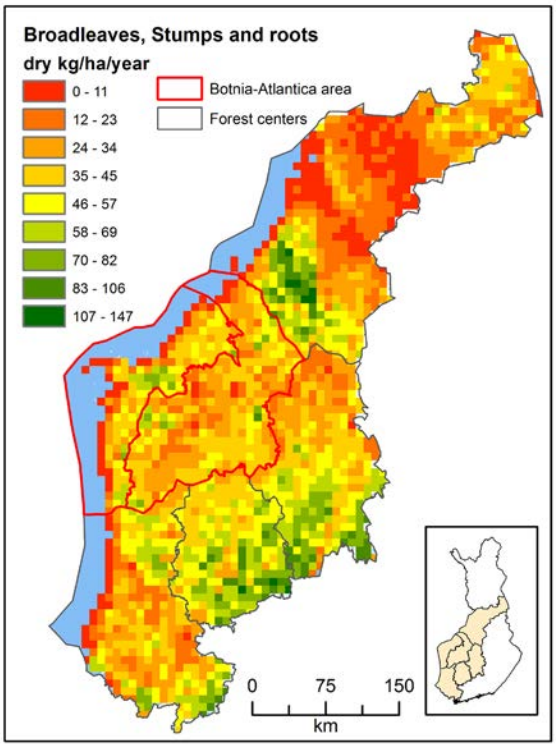

Figure 6. Potential outcome of broadleaved trees' stumps and roots biomass from loggings and its geographical distribution, dry mass kg/ha/year.

Table 1. Amount of harvestable biomass from stumps and roots in regeneration fellings within the Finnish Botnia-Atlantica area and the neighboring forest centers. RaP = Rannikko Pohjanmaa, L-S = Länsi-Suomi, Pir = Pirkanmaa, E-P = Etelä-Pohjanmaa, K-S = Keski-Suomi, P-P = Pohjois-Pohjanmaa.

Stumps	RaP	L-S	Pir	E-P	K-S	P-P	Roots	RaP	L-S	Pir	E-P	K-S	P-P
pine							**pine**						
1000 t/year	17	64	42	70	60	91	1000 t/year	54	210	136	219	194	279
kg/ha/year	34	60	46	52	43	34	kg/ha/year	108	197	148	162	139	105
spruce							**spruce**						
1000 t/year	22	52	66	36	78	49	1000 t/year	83	193	244	138	286	188
kg/ha/year	44	49	72	27	56	18	kg/ha/year	166	181	265	102	204	70
broadleaves							**broadleaves**						
1000 t/year	9	18	19	17	21	28	1000 t/year	27	58	63	56	71	89
kg/ha/year	18	17	21	13	15	10	kg/ha/year	54	54	68	41	51	33
total							**total**						
1000 t/year	48	134	127	123	159	168	1000 t/year	164	461	443	413	551	556
kg/ha/year	96	126	139	92	114	62	kg/ha/year	328	432	481	305	394	208

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