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Roundwood potentials and distribution in the Finnish side of Botnia-Atlantica

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 area. In Finland we used MS-NFI data and data from MELA calculations to find out the most potential areas for roundwood outcomes of different tree species. Results showed that there are differences in different areas when it comes to the potential roundwood outcome levels. Also differences in outcomes between regeneration fellings and thinnings are remarkable in certain areas.

INTRODUCTION

Data from 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 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).

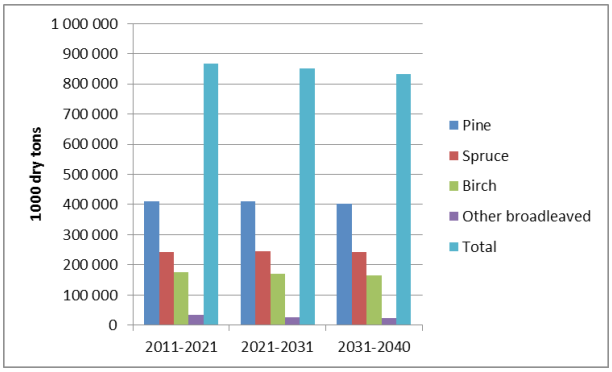

Figure 1. Biomass of living stemwood (1000 dry tons) in Finland and the development according the maximum sustainable harvesting level.

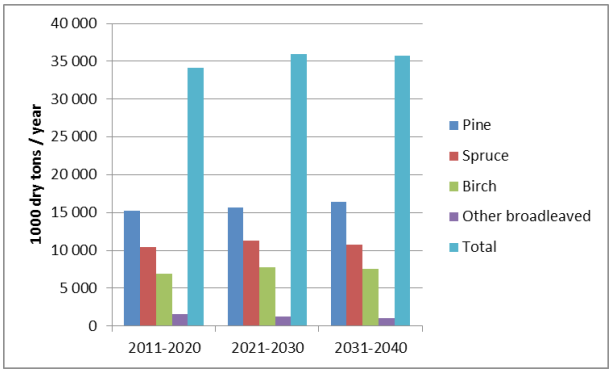

Figure 2. Stemwood removals (1000 dry tons / year) in Finland and the development according the maximum sustainable harvesting level.

The method described in this paper combines the results calculated with the aid of the MELA system with the forest resource information of 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 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 to 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 is 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 input data in our calculation method. In the calculation phase, we distributed the biomass assortment information to 8 km x 8 km gridcells 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 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 centers 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

According to our calculations highest harvestable potential of spruce roundwood is located in the south part of the study area (Figure 4). Especially Pirkanmaa (Pir) and Keski-Suomi (K-S) forest centers have high roundwood potential of spruce both when it comes to total potential of the area and to hectare wise potential (Table 1). Inside the Botnia-Atlantica region, areas near to the coast have bigger spruce roundwood potential than inland areas (Figure 4). That can also be seen from Table 1, when looking the hectare wise results where the absolute amounts are proportioned to the area of forest centers.

The differences between regeneration fellings and thinnings are quite small when it comes to the geographical distribution of spruce roundwood potentials. However, an interesting stemwood potential concentration from thinnings can be seen in the south part of Pohjois-Pohjanmaa (P-P) forest center.

Pine

Pine roundwood potential is quite equally distributed among forest centers, though biggest potentials can be found from inland areas and lowest near the coast line (Figure 5). When it comes to the total potential of pine roundwood, forest center Pohjois-Pohjanmaa (P-P) has the biggest potential whereas Rannikko Pohjanmaa (RaP) forest center has the lowest one. However, proportioned to forest land area the most potential forest centers are Länsi-Suomi (L-S) and Etelä-Pohjanmaa (E-P). (Table 1)

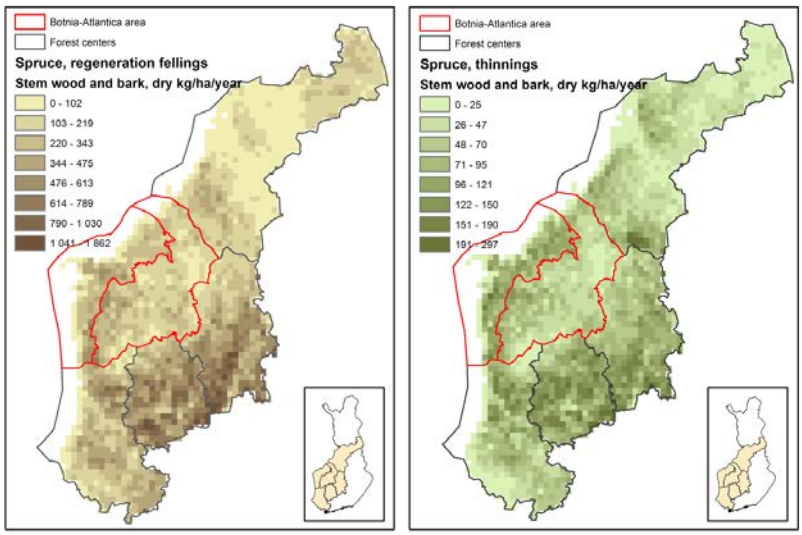

Figure 4. Geographical distribution of roundwood (stem and bark) potential of spruce, dry mass kg/ha/year.

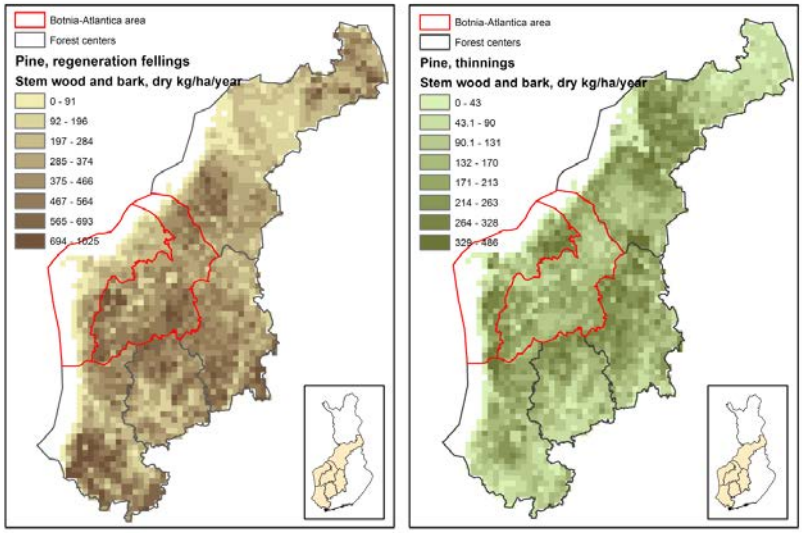

Figure 5. Geographical distribution of roundwood (stem and bark) potential of pine, dry mass kg/ha/year..

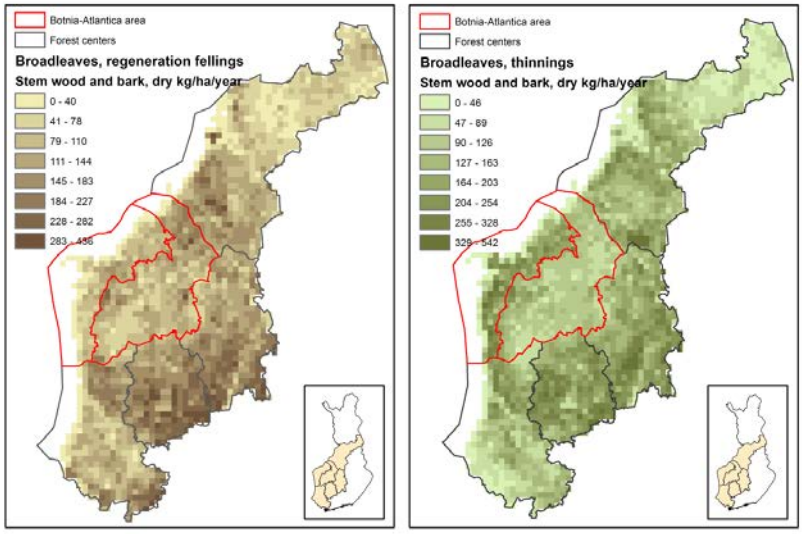

Figure 6. Geographical distribution of roundwood (stem and bark) potential of broadleaved trees, dry mass kg/ha/year.

Also In Botnia-Atlantica area Rannikko Pohjanmaa (Rap) and Etelä-Pohjanmaa (E-P) forest centers are quite equal what comes to pine hectare wise roundwood potential (Table 1). Differences between regeneration fellings and thinnings are notable. In Pohjois-Pohjanmaa (P-P) forest center the north part of the area has remarkable pine roundwood potential from regeneration fellings, but in the south areas of Pohjois-Pohjanmaa (P-P) the potential is small. When considering thinnings the situation is rather the opposite. (Figure 5).

Broadleaved trees

In broadleaves category the most important tree species is birch. The amounts and utilization of other broadleaved tree species are much smaller (Table 1). Potentials of broadleaves roundwood are quite equally distributed over the case study area, except that the most northern part of the case study area do not show as much potential (Figure 6). The best areas when it comes to hectare wise potential are Pirkanmaa (Pir), Rannikko Pohjanmaa (RaP) and Keski-Suomi (K-S) forest centers.

In Botnia-Atlantica area the areas near the coastline and Keski-Pohjanmaa district have high potential for broadleaves roundwood. There are also differences in geographical distributions between potentials got from regeneration fellings and thinnings. Thinnings in Botnia-Atlantica area are concentrated in the area near the coast line. Exception to other tree species in the broadleaves category, the biggest roundwood potentials come from thinnings (Table 1).

AUTHORS
Ron Store
Natural Resources Institute Finland (Luke)
ron.store@luke.fi
Dimitris Athanassiadis
Swedish University of Agricultural Sciences (SLU)
dimitris.athanassiadis@slu.se
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Table 1. Amount of roundwood from regeneration fellings and thinnings, dry biomass 1000 tons/year and kg/ha/year. Finnish Botnia-Atlantica area: RaP = Rannikko Pohjanmaa, L-S = Länsi-Suomi, Pir = Pirkanmaa, E-P = Etelä-Pohjanmaa, K-S = Keski-Suomi, P-P = Pohjois-Pohjanmaa.

	Regeneration fellings						Thinnings					
Tree species	**RaP**	**L-S**	**Pir**	**E-P**	**K-S**	**P-P**	**RaP**	**L-S**	**Pir**	**E-P**	**K-S**	**P-P**
pine												
1000 t/year	217	848	572	934	830	1135	174	275	214	317	377	593
kg/ha/year	434	796	621	689	593	425	348	258	232	234	269	222
spruce												
1000 t/year	248	586	781	416	891	528	83	128	166	104	181	171
kg/ha/year	496	550	847	307	636	198	166	120	180	77	129	64
birch												
1000 t/year	55	184	214	196	264	304	149	204	239	200	321	419
kg/ha/year	110	173	232	145	189	114	298	191	259	148	229	157
other broadl.												
1000 t/year	25	68	69	36	54	56	25	41	67	30	63	48
kg/ha/year	50	64	75	27	39	21	50	38	73	22	45	18
total												
1000 t/year	546	1687	1636	1582	2039	2023	430	647	685	650	942	1231
kg/ha/year	1093	1583	1775	1167	1457	758	861	607	743	480	673	461

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