

# Forest Inventories in Nordic Countries

26<sup>th</sup> January, 2017

Kari T. Korhonen

based on manuscript: **Forest inventories in Nordic countries – roadmap for the future**

Annika Kangas, Kari T. Korhonen, Mats Nilsson, Håkan Olsson, Jonas Fridman, Johannes Breidenbach, Rasmus Astrup, Thomas Nord-Larsen, Erik Næsset, Terje Gobakken & Matti Maltamo

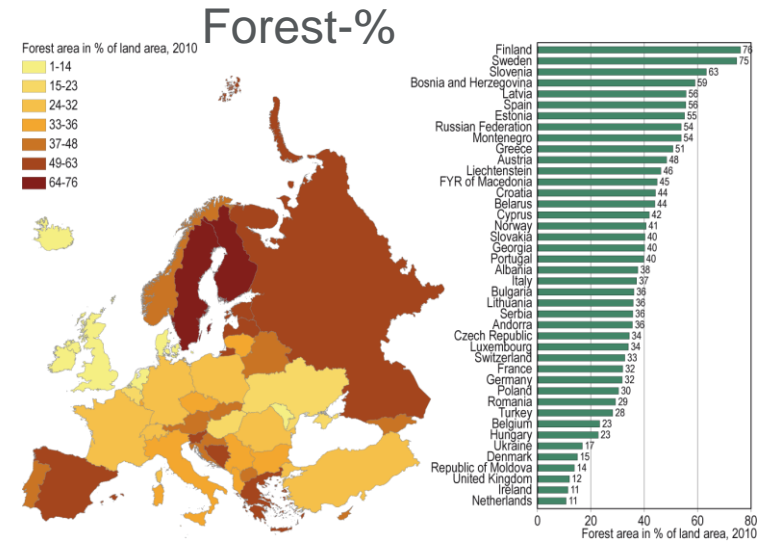
# Contents

- Background
- The Questionnaire
- Preliminary findings

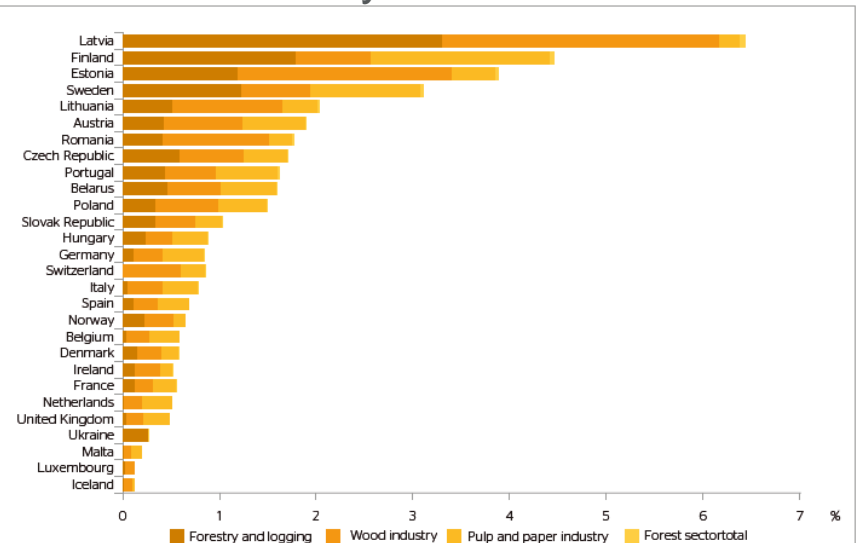
# Forestry in Finland

- Forest land 20.3 mill. ha
- Growing stock 2.3 bill. m<sup>3</sup>
- Annual increment 104 mill. m<sup>3</sup>/a
- Forest ownership:

- Private 61%: 630 000 forest owners
- State, municipalities, ... 28%
- Limited companies 9%
- Jointly owned forests 2%



## Share of forestry sector from GDP:



# NFI and forest management planning

Two inventory systems in Finland:

## 1) NFI for country & regional level monitoring

- based on systematic sampling
- exact field measurements, supported by satellite images
- covers all land, all owner groups, all land use classes

## 2) Forest Management Inventory for operative planning

- stand level inventory
- by Forestry Center for private forests, by Metsähallitus and forest companies for their own forests



# "Recent" development in NFI

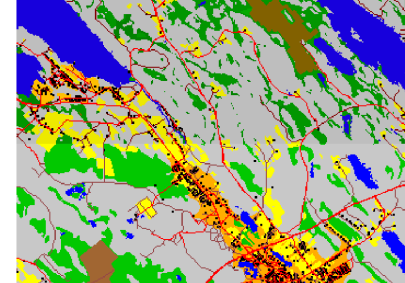
NFI sample plots



Satellite imagery



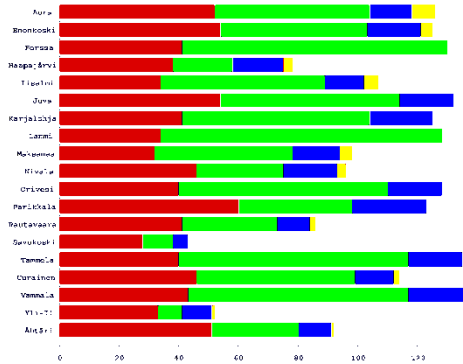
Map data



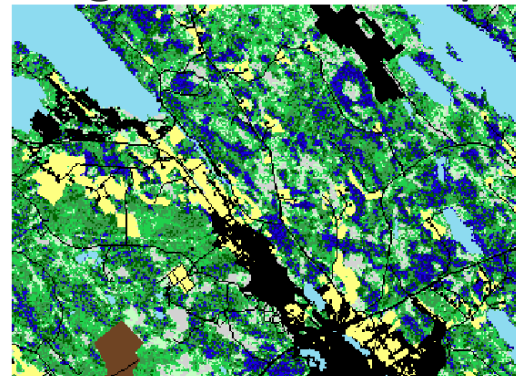
Knn estimation



Statistics



Digital forest maps

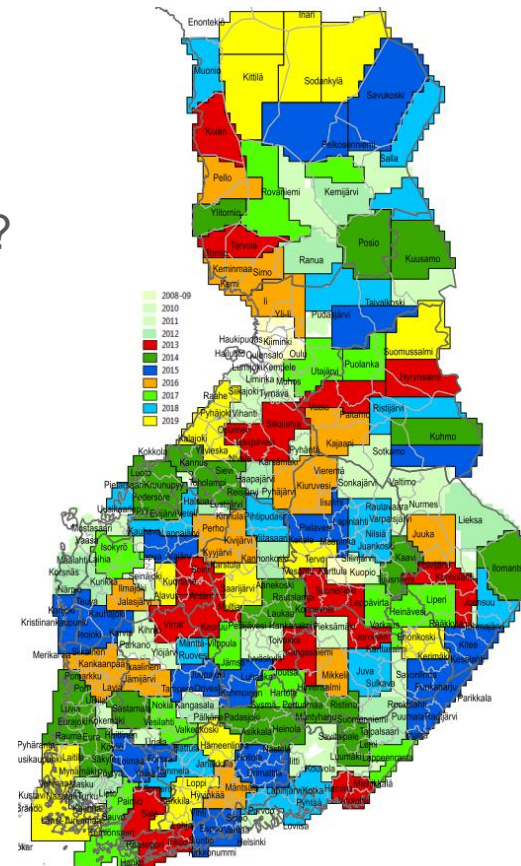


# Recent development in FMI

- 1) Laser scanning and aerial images
- 2) Field plot measurements, plots selected to represent all kind of forests
- 3) Classification of laser scanning data -> Wall-to-Wall forest resource information (pixel size 16 meters by 16 meters)
- 4) (Management plan)



- NFI produces stand level data
    - could this serve operative planning?
  - FMI develops towards regional data collection
    - do we need sampling based NFI?
- Are two separate systems justified ?
- How our neighbouring countries are solving forest resource data collection?



## Method: Questionnaire

- 1. Please briefly describe your current system to produce national level forest information.**
- 2. Data sources in current NFI**
- 3. Do you have national level wall-to-wall forest resource data? Are these freely available? What is the temporal and spatial resolution? What is the data content? Where the data are used?**
- 4. Do you have management planning inventories in private forests? Is it supported by government?**
- 5. Methodology for management planning inventories in private forests? Responsible organisation**
- 6. Near future (5 years) development of NFI**
- 7. Near future (5 years) development of management planning inventory**

# Preliminary findings (1)

Current NFI method and data production

- in all countries the field sampling method is very similar (5 year sample, with 1/5<sup>th</sup> of plots measured annually)
- in all countries the official statistics are produced for the similar administrative unit (counties or similar) and using the field plot data, only
- in all countries satellite images are used as additional data for specific products but not for official statistics. Field data supported by map data are the data sources for official statistics.

## Preliminary findings (2)

Forest resource maps produced with NFI data and satellite images

- FI and SE: forest resource maps are produced with a cycle of 2-3 years (FI) or 5 years (SE) using Landsat/Spot type of satellite images.
- NO produced only once (1996).
- freely available in FI, SE, NO

# Preliminary findings (3)

Lidar data based forest resource/FMI data

- FI: production started 2011 and the first round will be completed appr. 2020, detailed data, eg. volumes by tree species, separate from NFI.
- SE: full cover raster data were produced once (in 2015?) using NFI plots as main ground truthing data, information content low as compared to FI (only stem volume, above ground tree biomass, basal area, and basal area weighted mean diameter and tree height, no species data).
- NO: the FMI data covers only private forests and are available only for the owners.
- DK wall-to-wall map was produced using lidar data 2006-2007 and NFI plots, data are not available for public.

# Preliminary findings (4)

## FMI system

- FI: Forestry Center collects the data for FMI using lidar data and field plots that are separate from NFI, data collection paid by government.
- SE and DK: FMI is not subsidized, not coordinated. Method typically based on the use of aerial images, but in both countries increasingly on lidar data.
- NO: FMI is done by private companies, heavily subsidized by government. Based on lidar data, photo interpretation and field work.

## Preliminary findings (5)

### Future plans for NFI

- FI: improving small area estimates with the use of (Sentinel) satellite image
- SE: inclusion of alpine region (fjällen) in NFI, improving small area estimates with the use of forest resource maps produced with 3D data (lidar or stereo aerial images) and satellite images
- NO: wall-to-wall forest maps and municipal level estimates of forest resources using 3D data (lidar data or aerial images) and NFI plots
- DK: Using the new (2014-15) LiDAR data, the team behind the Danish NFI is currently developing a growing stock and biomass map for entire Denmark. It is the intent to make the map public.

# Preliminary findings (6)

## Future plans for FMI

- FI: data comes available in raster format; updating procedures are developed; most cuttings are updated in the data base using information from forestry operators and RS change detection; common platform based on data fusion of data from different sources is planned for; 5 year national programme for laser scanning under preparation
- SE: Lantmäteriet has started production of 3D point clouds from digital photogrammetry, this could be an aid for delineation of forest stands, estimates of growth on grid cell level, and automated estimates which however not are equally accurate as those made from laser scanning data. Discussions about renewed national laser scanning, as well as updating of the free product “skogliga grunddata”, using data from laser scanning or digital photogrammetry, but no decisions have been taken yet.
- NO: The (additional) use of NFI field plots in FMIs will be studied.
- DK: The new growing stock and biomass maps currently being developed will include segmentation of the forest area into “forest stands”. The segmentation along with volume estimates may be used for forest management planning and will be made freely available.

## Preliminary findings (7)

Expected role of remote sensing (RS) in forest data collection

- all countries plan to continue use of Sentinel/Landsat satellite images
- SE has started production of 3D cloud points from stereo aerial images, FI is studying this, NO?
- in NO and SE laser scanning for management planning is not coordinated, coordination is under discussion

Thank you!