The German National Forest Inventory: an instrument for data provision and beyond

Gerald Kändler
Baden-Württemberg Forest Research Institute
Department of Biometry

Overview

• Brief review
  – German NFI history
• The design of the German NFI
• How NFI-statistics is used: some results
• Some general considerations
  – Current and future challenges
  – Methodological issues and enhancements
• Summary and outlook
National forest inventory – a brief review

NFI
• Sample-based large scale inventory
• Statistical design
• First established in Scandinavia

Large scale inventories in Germany

• Bavarian Forest Inventory 1970/71
• By Amendment of the Federal Forest Act: Federal Forest Inventory „Bundeswaldinventur“ (BWI)
  – 1986-89: in West-Germany
  – 2001/02: in re-unified Germany
  – 2010: Amendment of Forest Act: 10 year interval
  – 2011/12: 3rd BWI
Motivation

- Overview on large scale forest conditions and forest productivity using
  - Consistent procedures
  - Permanent design: re-measurement

Competences & Tasks:

- Federal Government: central coordination, data management, data processing & reporting
- Federal states (Länder): survey (field work = data collection)

Baden-Württemberg: FVA (Forest Research Institute, Dep. of Biometry)
- Data collection and validation (quality assurance)
- R & D for the federal government: Forest development and wood supply model; biomass functions
- Data processing, analysis, and reporting for the forest in Baden-Württemberg
Inventory design: Sampling grid

Inventory design: Sampling grid with clusters (tracts)
Inventory design: Sampling grid with clusters (tracts)

Cluster status
- Forest cluster: at least one plot (corner) in forest
- Forest/Non-forest decision uncertain
- Non-forest cluster: entirely in built-up area or in a body of water
- Non-forest cluster: entirely in open countryside

Note: the grid covers the total area!
Angle-count sampling (factor 4): trees with D.B.H. >= 7 cm

- r = 25 m: Site characteristics
- r = 10 m: trees up to 4 m height, ground vegetation
- r = 2 m: trees > 50 cm and D.B.H. < 7 cm
- r = 1 m: trees of 20 cm to 50 cm in height
- r = 5 m: deadwood

Inventory design: survey procedures

Permanent plots = retrievable plots

- Permanent marking of the subplot centre (by metal rod in the ground, invisible, auxiliary markers, tract coordinates)
- Recording of tree positions (polar coordinates) → assessment of growth and drain at consecutive survey
Inventory design: forest (stand) borders

Forest edges surveyed in a **25 m radius around** plots located in the forest

---

NFI data: what are they used for …

A word on terminology

- **Data**: measurements or observations
- **Statistics**:
  - Generally: best practices to convert data into **meaningful, actionable information - particularly in the presence of uncertainty**!
  - Specifically: a numerical summary of data, e.g. the mean
Forest Area and Growing Stocks: A few results from Baden-Württemberg

Shift of tree species proportion from 1987 to 2012
Structure of growing stock 1987 to 2012 (d.b.h. size distribution)
## Increment and drain

- Period 2002 bis 2012
- Increment: mean annual volume growth \([m^3/ha/year]\)
- Drain: mean annual removals (cut and mortality) \([m^3/ha/year]\)

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Increment</th>
<th>Drain</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ownerships</td>
<td>12.3</td>
<td>11.61</td>
</tr>
<tr>
<td>State forest</td>
<td>11.5</td>
<td>10.76</td>
</tr>
<tr>
<td>Communal forest</td>
<td>11.8</td>
<td>11.28</td>
</tr>
<tr>
<td>Private forest</td>
<td>13.4</td>
<td>12.61</td>
</tr>
</tbody>
</table>

![Graph showing increment and drain for different forest ownerships](image)
Deadwood stocks per ha in the Baden-Württemberg forests 2012

Deadwood stocks 2002 versus 2012
Deadwood stocks 2002 versus 2012

Germany: Carbon stocks

Living Tree Biomass incl. Roots

1.236 Mio. t = 115.5 t/ha

West Germany  East Germany
Some general considerations regarding the role of NFIs

Current challenges for forest management

- Risks for forest ecosystems due to …
  - Environmental stress (pollution, …)
  - Global change
- Increasing relevance of …
  - Renewable resources
  - Non-timber functions
  - Conflict of goals
### Current challenges for forest management and conservation

- **On a global scale …**
  - Population growth, urbanization
  - Deforestation
  - Increasing pressure on remaining forests: degradation

### NFI - Requirements

- **Goals, purpose, use**
  - Monitoring sustainability
    - Current forest state
    - Future forest conditions (projection of forest development and wood supply)
  - Data and statistics for policy, national economy, and science
### NFI - Requirements

- Consistent methods (in space and time)
- Timeliness
- Accuracy and precision
- Long-term considerations: trend analyses
  - Past evolution of increment, removals, growing stock
  - Assessment of future trends (projection)

### NFI – Further developments

Current Requirements and future relevance
<table>
<thead>
<tr>
<th>NFI – Information pool for ...</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adaptive</strong> forest management</td>
</tr>
<tr>
<td><strong>International reporting commitments</strong></td>
</tr>
<tr>
<td>– Greenhouse-gas inventory (Kyoto-Protocol)</td>
</tr>
<tr>
<td>– Convention on Biodiversity</td>
</tr>
<tr>
<td>– Forest Resource Assessment (FRA) of FAO</td>
</tr>
<tr>
<td>– State of Europe’s Forests (former MCPFE, now Forest Europe)</td>
</tr>
<tr>
<td>– EU: Natura 2002</td>
</tr>
<tr>
<td>→ NFI as a tool for <strong>forest policy</strong> (national and international)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NFI – Information pool for ...</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wood industry</strong></td>
</tr>
<tr>
<td>– Raw material supply, investments</td>
</tr>
<tr>
<td>– „Forest-Wood-Cluster“</td>
</tr>
<tr>
<td><strong>Science and Research</strong></td>
</tr>
<tr>
<td>– Climate change</td>
</tr>
<tr>
<td>– Silviculture, Forest yield science, ...</td>
</tr>
<tr>
<td>– Biodiversity research</td>
</tr>
<tr>
<td>– Inventory technique and -methodology</td>
</tr>
</tbody>
</table>
Methodological Issues

**Implementation** (coordination and scheduling)
- „Interval“-Inventory
- Continuous Inventory
  - Regional
  - „Interpenetrating panel“ (USA, CH)

Methodological issues

NFI combined with **remote sensing**
- Small Area Estimates
- Map Form Estimates
Methodological issues

Wood resource projection: assessment of future wood supply
• Based on NFI data

Updating of inventories
• „model-based“ extrapolation
• „in-between“ survey (at midterm of interval)
Methodological issues

**Harmonization** of NFI-statistics for international common reporting

- Reference definitions
- “Building bridges”

Harmonization activities

**COST-Action E43:**

Harmonisation of National Forest Inventories in Europe: Techniques for Common Reporting

- WG 1: Harmonised Definitions and Measuring Practices
- WG 2: Harmonised estimation procedures for carbon pools and carbon pool changes
- WG 3: Harmonised indicators and estimation procedures for assessing components of biodiversity with NFI data

[www.metla.fi/eu/cost/e43/](http://www.metla.fi/eu/cost/e43/)
Harmonization activities

**COST-Action FP1001 – USEWOOD**
Improving Data and Information on the Potential Supply of Wood Resources
A European Approach from Multisource National Forest Inventories

**ENFIN**: European National Inventory Network: “Umbrella” of harmonization activities
EU Horizon 2020 Project: **DIABOLO** - Distributed, integrated and harmonised forest information for bio-economy outlooks

---

Summary and outlook

**NFI …**
- Major part of a comprehensive monitoring system
- Tool for multi-objective data provision
- Prerequisite for sustainable management
Summary and outlook

**Integrated Monitoring**
- „Horizontal“ = Integration of different monitoring systems
  - Soil inventory
  - Forest health monitoring …
- „Vertical“ = Integration large scale – small scale

Summary and outlook

**Enhancement to landscape inventory**
- Trees outside forest
- Open land biotope monitoring (Natura 2000)
References

- COST FP1001: Improving Data and Information on the Potential Supply of Wood Resources - A European Approach from Multisource National Forest Inventories (USEWOOD)
- German NFI web-site [www.bundeswaldinventur.de](http://www.bundeswaldinventur.de)
- Direct access to result database: [https://bwi.info](https://bwi.info)

Thank you for your attention!