Trends in growing stock and wood increment dynamics in Russian forests

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The ways for forest inventory in Russia

Forest management – basic information
Various types of forest monitoring - 6 types
Delegated authority completion reports (from 2008)
Forestry reports submitted to Federal State Statistics Service
State Forest Fund Account (SFFA) (up to 2008)
The first complete SFFA was conducted in 1956 and then conducted every five years
State Forest Register (SFR) has been conducted annually from 2008
### Principal forest characteristics based on SFFA-SFR data

<table>
<thead>
<tr>
<th>Year</th>
<th>Forest and other wooded land (million ha)</th>
<th>Forest area (million ha)</th>
<th>Growing stock (billion m³)</th>
<th>Annual average growing stock increment (million m³/yr)</th>
<th>Net annual increment (million m³/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>774</td>
<td>675</td>
<td>76.1</td>
<td></td>
<td>770</td>
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<tr>
<td>1961</td>
<td>848</td>
<td>695</td>
<td>77.5</td>
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<td>280</td>
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<tr>
<td>1966</td>
<td>813</td>
<td>706</td>
<td>77.6</td>
<td></td>
<td>20</td>
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<tr>
<td>1973</td>
<td>862</td>
<td>730</td>
<td>78.7</td>
<td></td>
<td>220</td>
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<tr>
<td>1978</td>
<td>881</td>
<td>750</td>
<td>80.7</td>
<td></td>
<td>400</td>
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<tr>
<td>1983</td>
<td>881</td>
<td>767</td>
<td>81.9</td>
<td></td>
<td>240</td>
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<tr>
<td>1988</td>
<td>884</td>
<td>771</td>
<td>81.6</td>
<td></td>
<td>-60</td>
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<tr>
<td>1993</td>
<td>887</td>
<td>764</td>
<td>80.7</td>
<td></td>
<td>-180</td>
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<tr>
<td>1998</td>
<td>882</td>
<td>774</td>
<td>81.9</td>
<td></td>
<td>240</td>
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<tr>
<td>2003</td>
<td>883</td>
<td>776</td>
<td>82.1</td>
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<td>40</td>
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<tr>
<td>2008</td>
<td>891</td>
<td>796</td>
<td>83.3</td>
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<td>2013</td>
<td>891</td>
<td>795</td>
<td>83.0</td>
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<td>-60</td>
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<tr>
<td>2014</td>
<td>891</td>
<td>795</td>
<td>83.0</td>
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<td>0</td>
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<tr>
<td>2015</td>
<td>891</td>
<td>795</td>
<td>82.8</td>
<td></td>
<td>-200</td>
</tr>
<tr>
<td>2016</td>
<td>891</td>
<td>795</td>
<td>82.8</td>
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<td>0</td>
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<tr>
<td>60 years increase</td>
<td>117</td>
<td>120</td>
<td>6.7</td>
<td></td>
<td>112</td>
</tr>
</tbody>
</table>

60 years increase
Forest area distribution by forest management periods (2016)

- **44%** over 20 years ago
- **19%** no more than 10 years ago
- **23%** 16–20 years ago
- **14%** 10–15 years ago
Causes of systematic errors in calculating growing stock

- Outdated forest management data
- Errors in the basal area per hectare tables and complete stand volume tables by density 1.0 (The Central Forestry Research Institute tables that have been used since 1940s).

- Disregarded are the following values:
  - Volume of stem from root collar to stump height
  - Volume of the top end of trunks of diameter at butt up to and including 8 cm
  - Volume of forest thinners of diameter under 8 cm

- Systematic underestimation of the growing stock up to 39%
- Systematic underestimation of the growing stock by forest evaluation – 10-30%
State Forest Inventory (SFI)

- A network of permanent inventory plots was established in 41 territorial entities of the Russian Federation
- An area of 348.7 million ha was digitized
- Some 52,200 inventory plots were established. Every permanent inventory plot served to collect data relating to 117 indicators.
# Comparison of average growing stock according to SFR and SFI data

<table>
<thead>
<tr>
<th>RF entity</th>
<th>Species/species group</th>
<th>Average growing stock (m$^3$/ha)</th>
<th>Difference</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SFR-2013</td>
<td>SFI</td>
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<tr>
<td>Altai Territory</td>
<td>Conifers</td>
<td>186</td>
<td>245</td>
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<tr>
<td>Bryansk Region</td>
<td>Conifers</td>
<td>221</td>
<td>364</td>
</tr>
<tr>
<td>Vladimir Region</td>
<td>Pine</td>
<td>199</td>
<td>245</td>
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<tr>
<td>Voronezh Region</td>
<td>Pine</td>
<td>225</td>
<td>285</td>
</tr>
<tr>
<td>Jewish Autonomous Region</td>
<td>Larch</td>
<td>116</td>
<td>270</td>
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<td>Kaluga Region</td>
<td>Conifers</td>
<td>211</td>
<td>360</td>
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<td>Kurgan Region</td>
<td>Conifers</td>
<td>195</td>
<td>172</td>
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<tr>
<td>Leningrad Region</td>
<td>Conifers</td>
<td>174</td>
<td>235</td>
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<tr>
<td>Lipetsk Region</td>
<td>All species</td>
<td>190</td>
<td>328</td>
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<tr>
<td>Nizhny Novgorod Region</td>
<td>Conifers</td>
<td>162</td>
<td>246</td>
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<tr>
<td>Novgorod Region</td>
<td>Conifers</td>
<td>156</td>
<td>172</td>
</tr>
<tr>
<td>Oryol Region</td>
<td>All species</td>
<td>96</td>
<td>282</td>
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<tr>
<td>Republic of Altai</td>
<td>Larch</td>
<td>188</td>
<td>183</td>
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<tr>
<td>Republic of Karelia</td>
<td>Conifers</td>
<td>103</td>
<td>207</td>
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<tr>
<td>Ryazan Region</td>
<td>All species</td>
<td>153</td>
<td>258</td>
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<tr>
<td>Smolensk Region</td>
<td>Conifers</td>
<td>168</td>
<td>290</td>
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<tr>
<td>Tambov Region</td>
<td>Conifers, pine</td>
<td>245</td>
<td>319</td>
</tr>
<tr>
<td>Tver Region</td>
<td>Spruce</td>
<td>189</td>
<td>253</td>
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<td>Tula Region</td>
<td>Conifers</td>
<td>267</td>
<td>451</td>
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<tr>
<td>Yaroslavl Region</td>
<td>Conifers</td>
<td>183</td>
<td>255</td>
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<tr>
<td><strong>Average values</strong></td>
<td></td>
<td>181</td>
<td>271</td>
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</tbody>
</table>
SFI – SFR – SFFA
Reasons for divergence of results

- Application of SFI measurement methods
- Different methods for generalization of results:
  - SFR – by most common timber species and working circles
  - SFI – by constituent timber species
Calculation formula:

\[ V_i = V_j + Z \times T, \]

where:

- \( V_i \) – theoretic growing stock in the accounting year \( i \), billion m\(^3\)
- \( V_j \) – theoretic growing stock in the accounting year \( j = i-T \), billion m\(^3\)
- \( Z \) – total annual increment over accounting period \( T \), billion m\(^3\)/year (SFFA-SFR data)
- \( T \) – accounting period, years
SFFA-SFR dynamics of total growing stock versus theoretic total growing stock changes calculated by summing up total annual increments (billion m³)
## Carbon stock in forests: a case study

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Russian Federation: - theoretic calculations</td>
<td>63,7</td>
<td>68,2</td>
<td>71,1</td>
<td>74,0</td>
<td>77,0</td>
<td>0,535</td>
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<td>- GFRA-2015</td>
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<td>49,4</td>
<td>49,5</td>
<td>50,1</td>
<td>50,6</td>
<td>0,025</td>
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<td>30,9</td>
<td>30,8</td>
<td>30,7</td>
<td>30,6</td>
<td>н/д</td>
<td>-0,015</td>
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<td>Brazil*</td>
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<td>1,1</td>
<td>1,1</td>
<td>0,007</td>
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<tr>
<td>Sweden*</td>
<td>1,7</td>
<td>1,7</td>
<td>1,8</td>
<td>1,8</td>
<td>1,8</td>
<td>0,006</td>
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<td>USA*</td>
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<td>23,1</td>
<td>23,9</td>
<td>24,7</td>
<td>25,0</td>
<td>0,133</td>
</tr>
</tbody>
</table>
Net annual increment in forests of the USA and Russia (m$^3$ per hectare and year) (GFRA-2015)
Net annual increment in forests of Sweden (m$^3$ per hectare and year) (Sammanställning, 2017)

**Growth per hectare (m$^3$sk ha$^{-1}$)**

- **All forests**
- **Productive forest**
- **Non-productive forest**

Year:
- 1990
- 1995
- 2000
- 2005
- 2010
- 2015
Net annual increment in forests of Finland
Global growing stock and annual increment per hectare
(GFRA-2015)
THANK YOU FOR YOUR ATTENTION!

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