How to harvest more or better forest products?

The economic effect of reduced regeneration investments on forest stand value – exemplified for European beech

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Traditional wood production of high quality

Even-aged natural regeneration of beech

<table>
<thead>
<tr>
<th>Costs (€/ha)</th>
<th>Consumption</th>
<th>Costs</th>
<th>Age from seed (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Num-ber</td>
<td>Unit</td>
<td>€</td>
</tr>
<tr>
<td>Preparation spraying</td>
<td>1</td>
<td>h/ha</td>
<td>134,4</td>
</tr>
<tr>
<td>Cleaning</td>
<td>3</td>
<td>h/ha</td>
<td>62,7</td>
</tr>
<tr>
<td>Soil preparation</td>
<td>7</td>
<td>h/ha</td>
<td>55,7</td>
</tr>
<tr>
<td>Fence</td>
<td>400</td>
<td>m/ha</td>
<td>3,4</td>
</tr>
<tr>
<td>Fence maintenance</td>
<td>1</td>
<td>h/ha</td>
<td>21,5</td>
</tr>
<tr>
<td>Fence removal</td>
<td>8</td>
<td>h/ha</td>
<td>40,3</td>
</tr>
<tr>
<td>Pre-commercial thinning</td>
<td>30</td>
<td>h/ha</td>
<td>17,0</td>
</tr>
<tr>
<td>Pre-commercial thinning</td>
<td>25</td>
<td>h/ha</td>
<td>17,2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
European beech – production forestry
Even-aged natural regeneration

Maximum value

Traditional regeneration investment range → high economic value

European Rural Development Programme investment level

Financial crisis regeneration investment range
- easy and fast decision to reduce costs
- DANGER → low economic value
Traditional wood production of high quality

Cash flow (beech, site index 1) (Forest rent criterion)

<table>
<thead>
<tr>
<th>Age</th>
<th>OS(0)*</th>
<th>OS(5)</th>
<th>OS(15)</th>
<th>OS(20)</th>
<th>TH(25)*</th>
<th>TH(35)</th>
<th>TH(45)</th>
<th>TH(55)</th>
<th>TH(65)</th>
<th>TH(75)</th>
<th>TH(85)</th>
</tr>
</thead>
<tbody>
<tr>
<td>€/ha</td>
<td>2238,7</td>
<td>6090,7</td>
<td>13690,6</td>
<td>4103,7</td>
<td>41,0</td>
<td>1765,7</td>
<td>1920,7</td>
<td>1928,7</td>
<td>1878,7</td>
<td>2115,1</td>
<td>2483,1</td>
</tr>
</tbody>
</table>

Average annual cash flow (AACF) = 425 €/(ha yr)

Expectation value (EV), r=2% (Soil rent criterion (EV))

<table>
<thead>
<tr>
<th>Age</th>
<th>OS(0)</th>
<th>OS(5)</th>
<th>OS(15)</th>
<th>OS(20)</th>
<th>TH(25)</th>
<th>TH(35)</th>
<th>TH(45)</th>
<th>TH(55)</th>
<th>TH(65)</th>
<th>TH(75)</th>
<th>TH(85)</th>
</tr>
</thead>
<tbody>
<tr>
<td>€/ha</td>
<td>28328,6</td>
<td>26995,8</td>
<td>22350,1</td>
<td>15066,7</td>
<td>14349,0</td>
<td>16583,4</td>
<td>18178,6</td>
<td>20024,6</td>
<td>22295,0</td>
<td>24974,8</td>
<td>27913,4</td>
</tr>
</tbody>
</table>

Expectation value (EV) (yr 0), r=1% = 49,400 €/ha

*OS = over storey removal, TH = thinning
### Reduced regeneration investment

<table>
<thead>
<tr>
<th>Costs (€/ha)</th>
<th>Consumption</th>
<th>costs</th>
<th>Age from seed (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Unit</td>
<td>€</td>
</tr>
<tr>
<td>Plants (ash, sycamore)</td>
<td>300</td>
<td>0,4</td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td>300</td>
<td>0,3</td>
<td></td>
</tr>
<tr>
<td>Fence</td>
<td>52</td>
<td>m/ha</td>
<td>3,4</td>
</tr>
<tr>
<td>Regeneration tending</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cash flow and expectation value with reduced regeneration investment

Assumptions: Forest rent (AACF) and soil rent criteria (EV)

Reduced regeneration investment
No degradation of logs
Real property tax included
No incentives
No income tax
No inheritance duty

Average annual cash flow (AACF): 460 €/(ha yr)
Expectation value (EV) (yr 0)
(before regeneration harvest):
  r=2%: 32,600 €/ha
  r=1%: 55,200 €/ha
Cash flow and expectation value with reduced regeneration investment

Assumptions: Forest rent (AACF) and soil rent criteria (EV)
"Chess board model": Equal relative reduction of investment and economic yield

Reduced regeneration investment by
\[(1.0 - 780 \, \text{€}/\text{ha}/3,880 \, \text{€}/\text{ha}) = 80\%\]
Reduced economic yield by 80% (except first over-storey removal)

AACF (1st generation): 344 €/(ha yr),
(2nd generation): 70 €/(ha yr)
(Loss: 81 €/(ha yr), 19%; 355 €(ha yr), 84%)
Expectation value (EV) (yr 0) (before regeneration harvest):
r=2%: 25,200 €/ha (loss = 7,400€/ha, 23%)
r=1%: 30,900 €/ha (loss: 24,300 €/ha, 44%)
Cash flow and expectation value with reduced regeneration investment

Assumptions: Soil rent criterion (2%)
Equal expectation value at yr 0
Economic break even point
Reduced cash flow from over-storey (2nd generation)

Standard regeneration 3,880 €/ha
Low regeneration investment 780 €/ha

Standard EV(2%) 28,300 €/ha
Low investment EV(2%) 32,600 €/ha
Equal EV (2%), 28,300 €/ha with reduced cash flow from over-storey = 26,500 €/ha (2nd generation) ≈ 90%
AACF (2nd generation) = 166 €/(ha yr)
Assumptions: **Soil rent criterion (1%)**
Equal expectation value at yr 0
Economic break even point
Reduced cash flow from over-storey

Standard regeneration 3,880 €/ha
Low regeneration investment 780 €/ha

Standard EV(1%) 49,400 €/ha
Low investment EV(1%) 55,200 €/ha
Equal EV (1%), 49,400 €/ha with reduced cash flow from over-storey = 9,400 €/ha (2nd generation) ≈ 32%
AACF (2nd generation) = 355 €/(ha yr)
Assumptions: Forest rent criterion
Economic break even point
Reduced cash flow from over-storey

Standard regeneration 3,880 €/ha
Low regeneration investment 780 €/ha

Standard AACF: 425 €/(ha yr)
Low investment AACF: 460 €/(ha yr)
Equal AACF, 425 €/(ha yr) with reduced cash flow from over-storey = 3,100 €/ha ≈ 10%
Assumptions: Forest rent and soil rent criteria
A logs converted to B logs – in 2nd generation
(10% A logs at 40-50 cm DBH)

Low regeneration investment 780 €/ha

EV(yr 0) with standard assortment
distribution and stumpage prices:
r=2%: 32,600 €/ha
r=1%: 55,200 €/ha
AACF: 460 €/(ha yr)
EV(yr 0) with A logs converted to B logs:
r=2%: 31,900 €/ha (loss = 2%)
r=1%: 52,900 €/ha (loss = 4%)
AACF: 417 €/(ha yr) (loss = 9%) (2nd generation)
Summary

Effect of low regeneration investment on EV and AACF

![Graph showing the change of EV/AACF (%) at different discount rates.](image-url)
Effect of reduced economic yield by 80% on EV and AACF

![Diagram showing the change in EV/AACF with different discount rates. The change in EV/AACF is represented on the vertical axis, while the discount rate is represented on the horizontal axis. The diagram shows a significant drop in EV/AACF with increasing discount rates.]
Summary

Necessary change of cash flow from over-storey to reach break even/
Possible reduction of cash flow from over-storey without economic loss
Effect of changing A logs to B logs

Change of EV/AACF (%) vs. Discount rate (%)
Climate change, environmental values & socio-economic evaluation

Strong or weak regeneration/high or low regeneration investment

Climate change issues
1. Health (adaptation/mitigation)
2. CO₂ sequestration (global warming)
3. Energy from wood
4. Species diversity
5. Biodiversity
6. Habitat protection/conservation
7. Water production
8. Recreation
9. Landscape
10. Hunting
11. Avalanche/soil erosion protection
12. Business-economic value

Environmental values

Socio-economic evaluation

FOREST & LANDSCAPE

FACULTY OF LIFE SCIENCES
UNIVERSITY OF COPENHAGEN
Conclusions

- Regeneration intensity is higher in countries with a forest rent foundation than in countries with a soil rent foundation.
- The value of forests is higher in forest rent countries than in soil rent countries.
- Traditional (in contrast with the trend following the financial crisis) high regeneration investments are preferred when the goal is to harvest more and better forest products in the future European forests.
Thank you for your attention!
More information

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