Long Log Harvesting
by Harvesters and Combination Forwarders

Udo Hans Sauter
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1 Objectives

- Forestry administrations confronted with demand for long logs by sawmills in southern Germany
- FVA was requested to investigate influences on productivity, costs and stand damages caused by mechanized harvesting methods providing long logs
2 Materials and Methods
2.1 Operating conditions: Study site

- **Altitude:** 1209 m - 1235 m (southern Black Forest)
- **Stand:**
  - Spruce: 27.2 ha
  - DBH: $\bar{x} = 33$ cm
  - Age: 67-100, $\bar{x} = 87$
- **Precipitation (mm):**
  
<table>
<thead>
<tr>
<th>period/year</th>
<th>July</th>
<th>August</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{x}$ 1981-2010</td>
<td>110</td>
<td>106</td>
<td>DWD, 2014</td>
</tr>
<tr>
<td>2014</td>
<td>123</td>
<td>133</td>
<td>Climate-data.org, 2014</td>
</tr>
</tbody>
</table>

- **Slope inclination:** 10 – 20 % / partially 30 %
- **Skid trail distances:** ~ 40 m
- **Cutting intensity:** 81 m³/ha
2.1. Operating conditions: soil types

- In all critical areas for the harvesting trial, the soil types provided stable conditions for machine operations.
- Only the CTL trial area was partly influenced by weak soil conditions.
2.2 Harvesters and forwarders used

**Tracked harvester:**
- Name: Königstiger Kern 30 TSS
- Engine power: 251 hp
- Weight: 34 t
- Crane reach: 15 m
- Net lifting capacity: 800 kg (15 m)
- Harvester head: Kesla 30 RH
- Weight harvester head: 1.2 t
- Felling diameter: 670 mm

**Wheel Harvester:**
- Name: John Deere 1470 E IT4
- Engine power: 255 hp
- Weight: 24.2 t
- Crane reach: 9.7 m
- Net lifting capacity: 120 kg (9.7 m)
- Harvester head: John Deere H 480 C
- Weight harvester head: 1.2 t
- Felling diameter: 680 mm

**Combination Forwarder (as clambunk skidder):**
- Name: HSM 208 F Kombi short chassis (8-Wheel)
- Engine power: 260 hp
- Weight: 20.5 t
- Payload: 12 t

**Forwarder:**
- Name: Komatsu Valmet 860.4
- Engine power: 197 hp
- Weight: 17.7 t
- Payload: 14 t
2.3 Variants of logging methods

Wheel Harvester
2.5 ha, short log logging on skid trail 1 - 8

Tracked harvester
2.5 ha, short log logging on skid trail 9 - 15

Tracked harvester
5.5 ha, long log logging on skid trail 16 - 23

Wheel Harvester
5.5 ha, long log logging on skid trail 24 - 29
2.4 Data collection and analysis

- Time studies based on continuous timing method for
  - motormanual felling (only felling)
  - fully mechanised harvesting (pre-skidding included)
  - skidding
- Calculation of the productive working hours ($PWH_{15}$)
- Calculation of the productive machine hours ($PMH_{15}$)
- Calculation of the labour productivity, the costs and the impact on the residual stand of the 4 variants
3.3 Roundwood measurement

• Measurements: Length and mean diameter

Fig.1: Long logs in loose stacks on the tracked harvester area before skidding.

Fig.2: Long logs in loose stacks on the wheel harvester area before skidding.
3 Results
3.1 Labour Productivity

<table>
<thead>
<tr>
<th>m³ / PMH₁₅</th>
<th>m³ / PWH₁₅</th>
<th>Fully Mechanised Harvesting (pre-skidding included)</th>
<th>Skidding</th>
<th>Motor/Manual Felling (only felling)</th>
<th>Total System</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wheel Harvester</td>
<td>Tracked Harvester</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>short logs</td>
<td>long logs</td>
<td>short logs</td>
<td>long logs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27.3</td>
<td>31.4</td>
<td>21.1</td>
<td>27.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17.3</td>
<td>20.4</td>
<td>15.9</td>
<td>20.4</td>
</tr>
</tbody>
</table>

m³ without bark
## 3.2 Costs

<table>
<thead>
<tr>
<th></th>
<th>Wheel Harvester</th>
<th>Tracked Harvester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>€ / m³</strong></td>
<td>short logs</td>
<td>long logs</td>
</tr>
<tr>
<td>fully mechanised harvesting</td>
<td>6.46</td>
<td>5.60</td>
</tr>
<tr>
<td>(pre-skidding included)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>skidding</td>
<td>4.96</td>
<td>4.75</td>
</tr>
<tr>
<td>motormanual felling</td>
<td>1.92</td>
<td>1.92</td>
</tr>
<tr>
<td>(only felling)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total system</td>
<td>13.34</td>
<td>12.27</td>
</tr>
</tbody>
</table>
## 3.3 Impact on the residual stand

<table>
<thead>
<tr>
<th>Impact on the residual stand (%)</th>
<th>Wheel Harvester</th>
<th>Tracked Harvester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>short logs</td>
<td>long logs</td>
</tr>
<tr>
<td>ZHB – Procedure</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Deuschel/F.Sauter – Method (Meng)</td>
<td>19</td>
<td>23</td>
</tr>
</tbody>
</table>

Removal (%) |
23 | 30 | 22 | 28
4 Conclusions
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- **Differences** between the variants in terms of **labour productivity** and **costs** are mainly caused by:
  - **working methods** of the machine operators (especially of the harvester operators)
  - **distribution of the wood quality**
  - **operating conditions**

→ The choice of logging method had only minor influence

- **Differences** between the variants in terms of the impact on the residual stand are mainly caused by:
  - **Sub-process swinging in the long logs** into the skid trails

→ The influence of the logging method was strong, but both methods caused still high damage rates
Thank you for your attention!
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