Innovating the competitive edge: from research to impact in the forest value chain

50th Anniversary of the International Symposium on Forestry Mechanization
Brasov, Romania, 25th-29th September 2017

Tractor Mounted Winching Systems for Small Scale Harvesting

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A Picture from Antalya

**Conference Venue**

50th Anniversary of the International Symposium on Forestry Mechanization, Brasov, Romania, 25th-29th September 2017

- **2015** Linz/Austria
- **2016** Warsaw/Poland or Antalya/Turkey
- **2017** 50th Anniversary Brasov/Romania
- **2018** Antalya/Turkey or Posen/Poland
- **2019** Volunteers are very welcome
Introduction

- Example of tractor mounted winching system from Mediterranean forest in Turkey
- Specifications, performances and costs of home-made winches
- Evaluating applicability within the scope of small scale
Small scale ...

- forestry
- operation
- harvest
- logging
- ownership
- unit

• Conventional forestry
• Individual ownership
• Smaller forest area
• Smaller harvest block
• Adaptive technology
• Inexpensive machinery
• Low level capital
• Individual income
• .....
Background

- State owned forestry (over 99%)
- Forest villagers are dependent on forestry income.
- Forest villagers (over 5 million) are subsidized by state
- The allowable trees are harvested by the villagers
- Few trees and few yield per household (50-150 tree or 30-200 m³)
- Limited allowable area as 15-20 ha per cutting compartment.
- The cutting blocks are fragmented by large number of villagers.
- Basic to intermediate technology level among the forest villagers
  - Felling by chainsaw
  - Skidding by usually gravity method, partly by tractor skidding, rarely skyline
  - Hauling by trucks and trailer
- Having poor technical equipment and lack of qualification
- Any special interest related to forestry works.
Background

- Heavy work load
- Unfavorable terrain condition
- Limited harvesting season
- Shortage in labor force
- Needing to comfortableness
- Increasing purchasing power
- Training on professionalization
Tractors in forest harvesting

- Low or medium power tractors are certainly cheaper
- It has inadequate technical characteristics
- The use of them in forest is limited
- They are used only when the working conditions so allow.
- They provide limited usability compared to more efficient machinery.
- The maximum operating is around 25-35% terrain slope.
Over the past few years there has been a widespread interest in farm tractor-mounted winches
Winches (Specifications)

Parts of winches
- Main frame
- Butt palet with blade
- Pulley
- Cable with hook
- Protective grill
- Connection devices
- Control stick
Winches (Specifications)

**Technical data**

- Pulling capacity: 3000-5000 kg
- Weight: 200-600 kg
- Cable diameter: 8-14 mm
- Cable length: 50-150 m
- Tractor power: 50 h or more
Winches (Types)

Factory-made winches

Home-made winches
Winches (Types)

PTO-shaft

Hydromotor
## Case studies

### Time analysis & Cost analysis

<table>
<thead>
<tr>
<th>Tracktors</th>
<th>Power (hp)</th>
<th>Wire rope</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New Holland-TD80-S</td>
<td>80</td>
<td>12</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>New Holland-TT55</td>
<td>55</td>
<td>8</td>
<td>100</td>
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<tr>
<td>New Holland-TT50</td>
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<td>10</td>
<td>120</td>
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<tr>
<td>Massey Ferguson 266 G</td>
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<td>10</td>
<td>150</td>
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<tr>
<td>Türk Fiat 55-56</td>
<td>55</td>
<td>8</td>
<td>100</td>
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</tbody>
</table>
Different winch types

- **Home-made winches**
  875 - 1500 €

- **Factory-made winches**
  2000 €
Case - 1

Species: Fir stands  
Treatment: Final felling  
Operation: Downhill skidding  
Method: Full (stem) length  
Tractor: Medium sized (66 hp)  
Winch: Factory-made  
Power: PTO shaft  
Distance: 65 m  
Slope: 15-20%

**Performance**  
Piece size: 1 per cycle  
Load size: 1.4 m³ per cycle  
Winching Cycle Time: 7.2 min  
Productivity: 11.2 m³/h

**Costs**  
Winch Investment: 2000 €  
Hourly Cost: 13.6 €/h  
Unit Cost: 1.2 €/m³

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Distribution of cycle time to components

- **Cable dragging to load**: 37%  
- **Hooking**: 16%  
- **Load Pulling**: 38%  
- **Unhooking**: 9%

Full length winching in fir stands

\[ y = 0.1671x^2 - 8.1422x + 187.86 \]

\[ R^2 = 0.912 \]
Case - 2

Species: Brutian pine stands  
Treatment: Final felling  
Operation: Downhill skidding  
Method: Full (stem) length  
Tractor: Medium sized (55 hp)  
Winch: Home-made  
Power: Hydromotor  
Distance: 30 m  
Slope: 5-10 %

Performance  
Piece size: 1 per cycle  
Load size: 0.4 m³ per cycle  
Winching Cycle Time: 4.2 min  
Productivity: 6.4 m³/h

Costs  
Winch Investment: 875 €  
Hourly Cost: 13.5 €/h  
Unit Cost: 2.1 €/m³
Case - 3

Species: Fir stands  
Treatment: Final felling  
Operation: Uphill winching  
Method: Cut-to-length  
Tractor: Medium sized  
Winch: Factory-made  
Power: PTO shaft  
Distance: 60 m  
Slope: 50 %

Performance
Piece size: 3 per cycle  
Load size: 1.1 $m^3$ per cycle  
Winching Cycle Time: 6.2 min  
Productivity: 13.4 $m^3$/h

Costs
Winch Investment: 3500 €  
Hourly Cost: 13.7 €/h  
Unit Cost: 1.02 €/$m^3$

Distribution of cycle time to components

CTL winching in fir stands
Case - 4

Species: Brutian pine stands
Treatment: Final felling
Operation: Uphill winching
Method: Cut-to-length
Tractor: Medium sized
Winch: Home-made
Power: Hydromotor
Distance: 60 m
Slope: 50 %

Performance
Piece size: 4 per cycle
Load size: 0.7 m³ per cycle
Winching Cycle Time: 6.4 min
Productivity: 7.6 m³/h

Costs
Winch Investment: 875 €
Hourly Cost: 13.5 €/h
Unit Cost: 1.8 €/m³

Distribution of cycle time to components

CTL winching in pine stands

\[ y = 0.0857x^2 - 4.8859x + 400.69 \]
\[ R^2 = 0.0826 \]
## Results

### Comparison some characteristics of winch systems

(powered by medium sized tractor (55-70 hp))

<table>
<thead>
<tr>
<th>Case</th>
<th>Winch Type</th>
<th>Winching Direction</th>
<th>Harvest method</th>
<th>Distance</th>
<th>Purchase</th>
<th>Productivity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case-1</td>
<td>PTO-Shaft</td>
<td>Downhill</td>
<td>Full Length</td>
<td>65</td>
<td>2000</td>
<td>11.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Case-2</td>
<td>Hydromotor</td>
<td></td>
<td></td>
<td>30</td>
<td>875</td>
<td>6.4</td>
<td>2.1</td>
</tr>
<tr>
<td>Case-3</td>
<td>PTO-Shaft</td>
<td>Uphill</td>
<td>CTL</td>
<td>60</td>
<td>3500</td>
<td>13.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Case-4</td>
<td>Hydromotor</td>
<td></td>
<td></td>
<td>60</td>
<td>875</td>
<td>7.6</td>
<td>1.8</td>
</tr>
</tbody>
</table>

- Utilizable for both uphill and downhill and also lateral
- Effective at 40-80 m winching/skidding distance (load size < 2000 kg)
- At the slope less than 20%; downhill skidding
- PTO powered (12.3 m$^3$/h) are productive than hydromotor powered (7 m$^3$/h)
- Productivity in uphill winching 10.5 m$^3$/h (operational delays are minimized in CTL)
- Productivity in downhill skidding 9 m$^3$/h (Full length harvesting)
- Average unit cost 1.5 €/m$^3$ less than traditional manual cost 7 €/m$^3$
Advantages

The tractor mounted winches could be:

- developed and used in line with the needs of the villagers themselves
- produced by small manufacturer or homemade atelier
- have low purchase and manufacturing price in spite of the imported one
- easily mounted on most medium to large-sized farm tractors
- an example of low cost effectiveness with poor equipment and qualification
- operated by untrained operators – workers
- utilizable in forest villages where even though insufficient interest in forest works
- an economical method of logging small area for a person who owns a farm tractor.

- By using these winches, forest villagers or loggers can handle timber harvest operations and supplement their income at a time when their tractor would otherwise be idle.

- Altered the CTL to Full Length harvesting system (if slope<20 %).
  - The manually working time was minimized in terms of human power
  - Net income of forest villagers relatively increased depending on operational cost
Disadvantages

The tractor mounted winching:

- need to one medium powered tractors, at least
- cause to unemployment within villagers
- limit the application in thinning-tending operations
- cause dirty logs during ground skidding
- induces soil and residual tree damage
- entail work safety and standardized protection which required more spending money
Conclusion

• Tractor mounted homemade winches can be mentioned one of good example of small scale harvesting in a developing country.
• Conversion of a farm tractor for seasonal small unit winching is easy and reasonably inexpensive
• During harvesting process, in smaller forest areas with small production capacity, through small scale technology, to improve the working conditions for safer works, it should be done that:

  ➢ Implementation of smaller, cheaper and adequate machines for forestry works pertinent to topography and stand conditions.
  ➢ To provide work safety, the winch equipment and tractors should be converted to protective mode
  ➢ To increase productivity, the occupational training should be given by recognized sources.
Thank you for your interest

Please do not forget!

You are invited to Turkey, very close to here!

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