Analysis of the procurement system of Eucalyptus residues with bundling technology

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INTRODUCTION: Eucalyptus plantations in Spain

- The area of Eucalyptus plantations is about 760,000 ha (plus about 650,000 in Portugal).
- Atlantic areas, both rainy oceanic (north) and dry mediterranean climate (south Spain).
INTRODUCTION: Eucalyptus plantations in Spain

- The output is 3,000,000 m³ underback
- Industrial consumption 4,650,000 m³
- Deficit 1,650,000 m³
  - 25% Portugal
  - 75% other

  4,000,000 m³ ub pulp production.
  450,000 m³ ub fibreboard.
  200,000 m³ mining and others.

- Most common method:
  - Coppice regeneration
  - Rotations between 9-14 years
  - 15-30 m³/ha.year
INTRODUCTION: Bioenergy in Spain

- Use of renewable energies: **13%** gross final energy consumption.
- Biomass: **50%** renewable energies.


- States that by 2020, **22.7%** of the gross final energy consumption will be provided by renewable energies.
- Establishes incentives to electric companies for the use of forest residues and short rotation forestry SRF.
INTRODUCTION: Bioenergy in Spain

- ENCE has three plants in Spain. 180 MW.
- ENCE Navia (Asturias): 77 MW installed power.
INTRODUCTION: Procurement of forest residues

Chainsaw + processor (processing, deliming, topping) at 7cm diameter

- Fire hazard
- Limit the accessibility to the field

Large amounts of residues left on the ground

A potential source of biomass
INTRODUCTION:

Procurement of forest residues

- Concentration
- Extraction
- Transport
- Comminution

It’s necessary to select adequate systems and technologies to perform it efficiently

To understand the processes well!
METHODOLOGY

• Northern Spain (Asturias)
• Eucalyptus (E. globulus) plantations.
• 14 years.
• Chainsaw + an excavator equipped with processing head
• BUNDLER + FORWARDER + TIMBER TRUCK

WORK TIME STUDY
- Four days
- Continuous time study
- Siwork3 software and GPS

Evaluate machine productivity and the harvesting system
BUNDLER  Woodpac ENFO 2000
BUNDLER Woodpac ENFO 2000

NEW CUTTING SYSTEM

Shears system
CHARACTERISTICS

Dingo 24-52A

- 147 kW
- 8 wheel drive

Guerra 77A

- 7.7 m reach

- Bundler: 1,5 years → 7,400 bundles.

Without any maintenance of the cutting device.
BUNDLER  Woodpac ENFO 2000

BUNDLES

• Length: 250 cm
• Diameter: 77.3 cm
• Volume: 1.17 m³
• Fresh weight: 371 kg
• Moisture: 44%
• Weight oven dry: 206 kg
TIME STUDY. PRODUCTIVITY

- Time 684 bundles
- 32.79 SMH
Break-down of bundling phases (%)

- Move: 21.0%
- Load: 14.9%
- Bundle: 14.3%
- Cut: 12.4%
- Tie: 8.9%
- Maintenance: 4.3%
- Other: 24.2%

Total: 73.26%
TIME STUDY. PRODUCTIVITY

- 684 bundles
- 32,79 SMH
- 89 % utilization rate (PMH$_{15}$/SMH)
- 8.8 t or 24 bundles (PMH$_{15}$
- 1)
- 7.7 t or 21 bundles (SMH$^{-1}$)

TIME STUDY. COST

- 90€ SMH$^{-1}$  →  4.3 € bundles$^{-1}$ or 11.6 € green ton$^{-1}$
FORWARDER  Dingo

CHARACTERISTICS

Dingo

• 92 kW
• 6 wheel drive
• 8.5 t payload

Guerra 624

• 6.9 m reach

• Has no forwarding distance along the forest roads (one way).
• Bundles were piled: roadside, intermediate landings or directly on truck.

• Vertical metal wall on the left side and posts on the right side.
TIME STUDY. PRODUCTIVITY

- 335 bundles
- 9.6 SHM
- 21 bundles average load
- 92% of nominal payload
- More than 90% operative time
- 35 bundles SMH\(^{-1}\) 13 green t SMH\(^{-1}\)

TIME STUDY. COST

- 52 € SMH\(^{-1}\) → 1.5 € bundle\(^{-1}\) or 4 € green ton\(^{-1}\)
CHARACTERISTICS

• Equipped with crane for self-loading.
ROAD TRANSPORT  Semitrailer truck

CHARACTERISTICS

• Posts or net-walls
CHARACTERISTICS

• Load volume: 65.6 m³
TIME STUDY. PRODUCTIVITY

- Average load: 69 bundles or 25.8 tons load$^{-1}$
- 29 to 49 min loading time
- 21 to 25 unloading time
- 140 km (3.5 h round trip)

TIME STUDY. COST

46 € SMH$^{-1}$ → 2.9-3.2 € bundles$^{-1}$ 7.7 - 8.4 € green ton$^{1}$
Storage and comminution

- Easier temporary storage at field/roadside.
- Easier and more efficient storage at the plant (higher piles, easier to handle).
- Low biomass losses and no self-ignition risks.
- Bundlers comminution by heavy duty grinders is very efficient (50-60 bundles/SMH).
Storage and comminution

Stationary grinder as planned by the power plant.
Conclusions

- The bundler has a productivity comparable to that reported for other machines (piled or windrowed residues).
- The cutting system (shears) appears to be slower than chainsaw but more reliable (lower maintenance cost).
- The studied system had an overall calculated cost of 9 €/bundle, thus with a very interesting economic margin (power plant buys for 12-13 €/bundle)
Thank you!

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