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Production and supply chain logistics to deliver sawdust for the use of animal bedding materials in livestock operations

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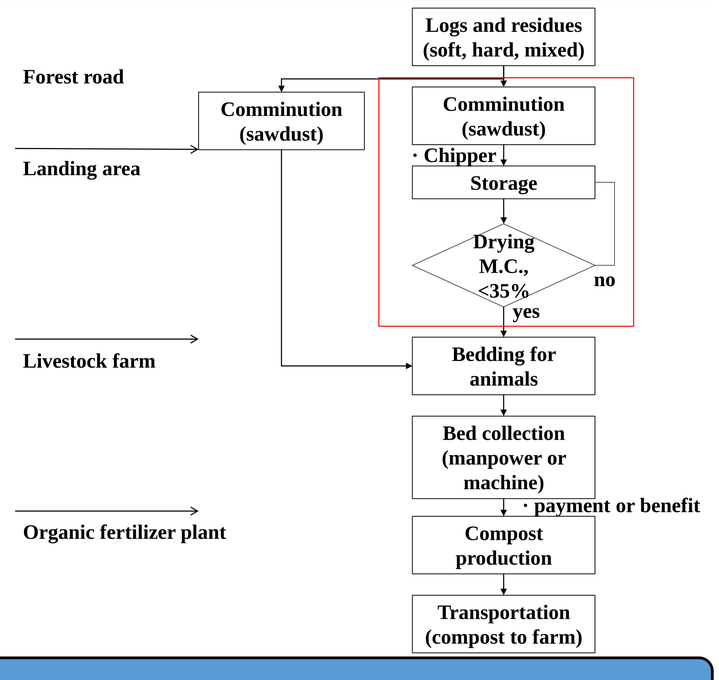
I. Introduction

- Forest residues of tree tops, limbs, and non-merchantable trees are a potential source for bioenergy and bioproducts.
- Bio-based bedding and absorbent products (i.e. sawdust) can be produced from woody biomass and used to improve animal health and reduce animal waste leaching, runoff, and associated contaminations.
- Additionally, a mix of animal wastes and sawdust is collected to produce high-value organic fertilizers that improve agricultural soil productivity in a sustainable manner.
- The objective of this study was to:
  - Determine the productivity and cost of producing sawdust from small-diameter hardwood (Oak) and softwood (Korean pine) stem wood using a mobile sawdust machine.
  - Evaluate the quality of sawdust for the use of animal bedding material, including bulk density, particle size distribution, and moisture content.



II. Materials and Methods

- Species used for the study
  - Korean pine (*Pinus koraiensis*) and Oak (*Quercus mongolica*)
- Measurement and data collection
  - Stem wood (diameter, length, weight), chipping time, fuel consumptions
  - Particle size distribution, bulk density, and moisture content
  - Sawdust processing productivity (tons/hour) and machine cost ($/hour)

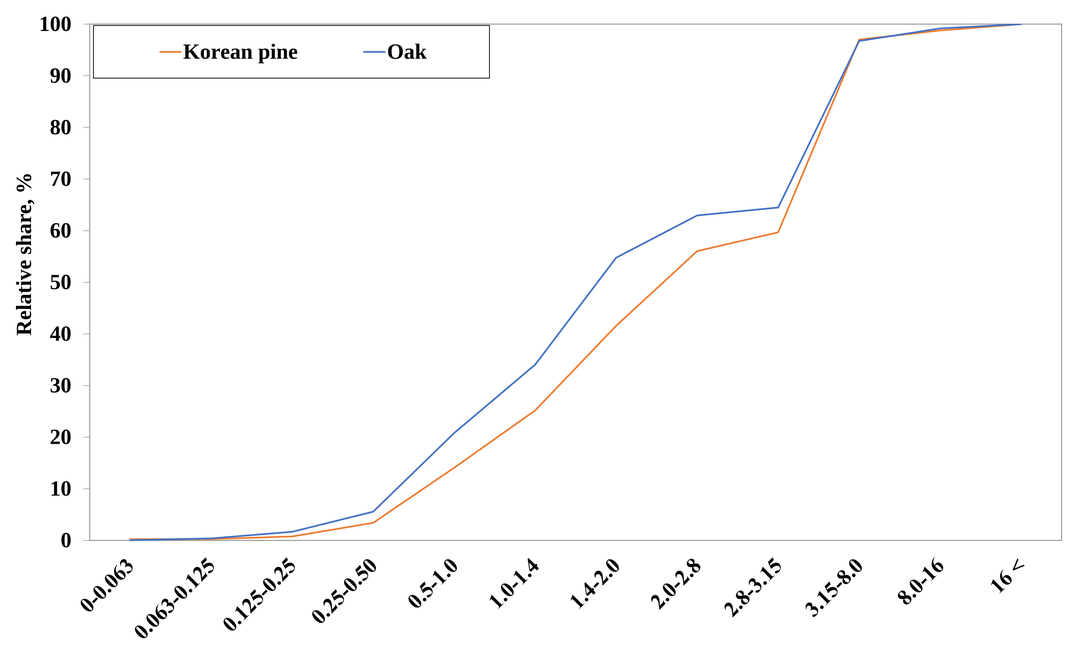
Fig. 1. Sawdust production from low quality wood using a mobile machine

- Particle size distribution (EN 15149-1:2010 standard)
  - Sieve class (mm; 0.063, 0.125, 0.25, 0.50, 1.00, 1.40, 2.00, 2.80, 3.15, 8.00, 16.00)
  - 20 minutes of sieving operations for each size class
- Bulk density (ISO 17828 standard)
  - Small container: D: 167mm, H: 228mm, Volume: 5 liters (0.005m^3)

Fig. 2. (L) Mechanical shaking device for particle size distribution, (R) small container for bulk density.

III. Results

- Raw material size : diameter (cm), length (m), volume (m^3)
  - Korean pine : 18.72±7.20, 2.26±0.37, 0.09±0.07
  - Oak: 13.24±4.75, 2.17±0.22, 0.04±0.03
- Bulk density (kg/m^3) and moisture content (%) :
  - Korean pine : 207kg/m^3 and 22.2%, - Oak : 221kg/m^3 and 28.4%
- Particle size distributions



- Comminution productivity (m^3/hr) and cost ($/m^3) :
  - Korean pine : 15.6m^3/hr and $13.7/m^3 - Oak : 9.3m^3/hr and $22.9/m^3

Classification	Productivity (m^3/hr)	Fuel consumption (liter/hr)	Machine cost ($/hr)	Cost ($/m^3)
Korean pine	15.6	39.4	213.50	13.7
Oak	9.3	32.7		22.9

IV. Conclusion

- Particle sizes and moisture content are important factors to provide livestock bedding for animal health and water quality(reducing animal waste leaching and runoff) so we evaluated the bulk density, moisture content, and particle size distributions on Korean pine and Oak.
- The productivity and cost of comminution were 15.6 m^3/hr (Korean pine), 9.3 m^3/hr (Oak) and $13.7/m^3 (Korean pine) and $ 22.9/m^3 (Oak), respectively.
- In the future, we need to study supply chain of sawdust from forest to organic fertilizer plan and to evaluate the quality of sawdust in animal health, soil productivity, and organic fertilizer.