

Productivity norms for harvesters and processors used in Italy



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Italian harvesters: the series



Productivity norms

- Beyond single tests
- e.g. Brunberg 1995-97
- Nurminen et al. 2006



The study

- 10 years
- 38 tests, 19 operators
- 15,148 cycles
- 60% excavator-base
- Partitioned 70-30
- Same investigators



Six equations

- Move at Deck = f (vol)
- Move in stand = f (slope, power, type, tree density)
- Brush = f (forest or plantation)
- Grab = f (vol, power, machine)
- **Fell** = f (vol, power, slope, machine)
- **Process** = f (vol, slope, tree, power, machine, processor)
- Accessory time % = 15 (harvest) or 30 (process)



Validation

Eq. no. ¹	Element	Actual	Predicted	Δ % ²	t-test p	r ² val. ³	r ² pred. ³
1	<i>Move at deck</i>	7.5	7.1	-5.3	0.559	0.009	0.008
2	<i>Move in stand</i>	19.6	14.4	-26.5	<0.0001	0.098	0.091
3	<i>Brush</i>	1.2	1.1	-8.3	0.458	0.051	0.020
4	<i>Grab</i>	22.0	21.2	-3.6	0.158	0.121	0.162
5	<i>Fell</i>	29.2	26.8	-8.2	<0.0001	0.401	0.472
6	<i>Process</i>	67.6	68.2	0.9	0.701	0.685	0.670
-	Total at Deck	99.7	97.8	-1.9	0.068	0.684	-
-	Total in Stand	114.5	110.5	-3.5	0.002	0.558	-

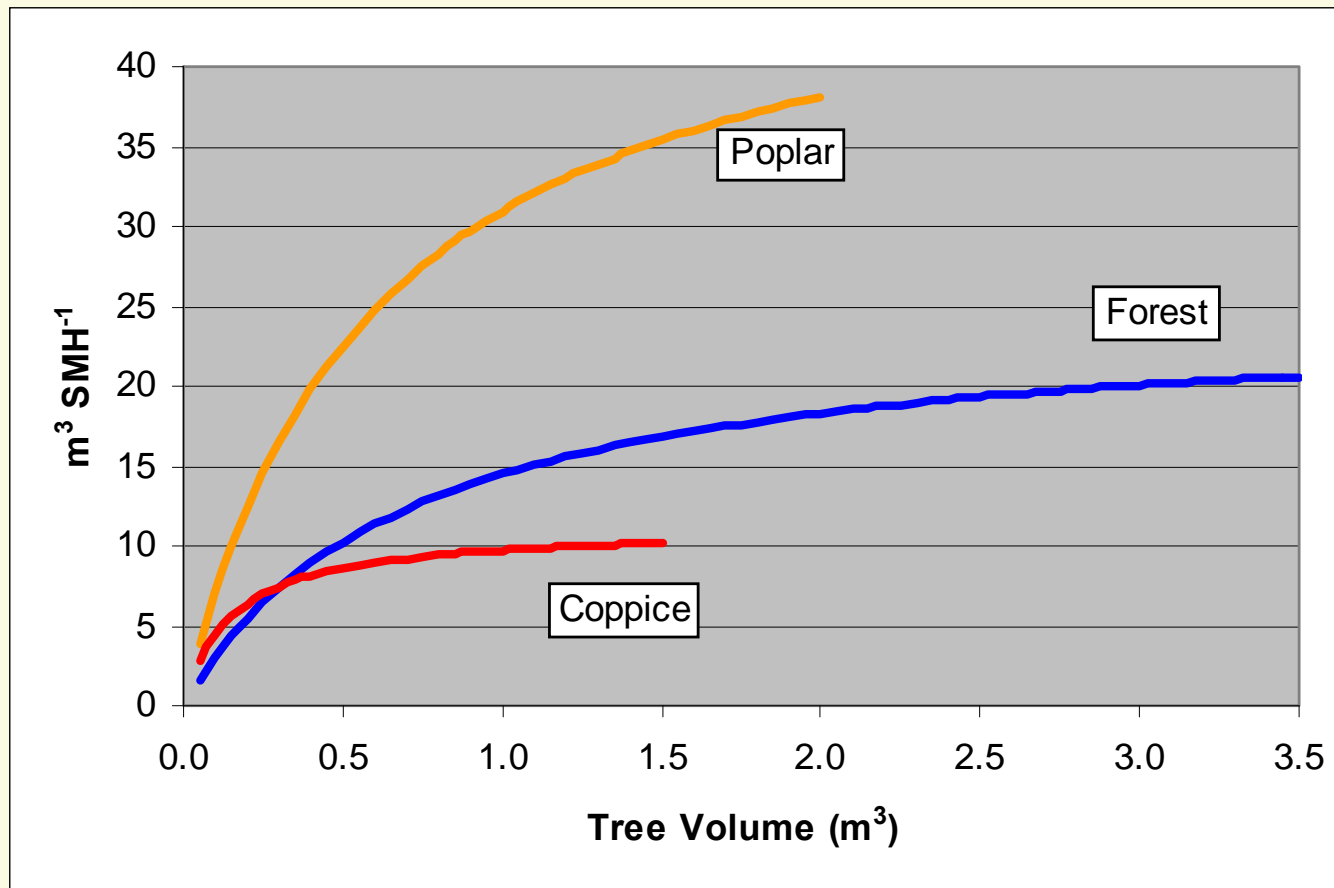
Strengths and Weaknesses

- Representative (large number of units)
- Reliable (large number of obs., same investigator)
- Reasonably accurate (r^2 process)
- Simple (few variables)
- Missing parameters

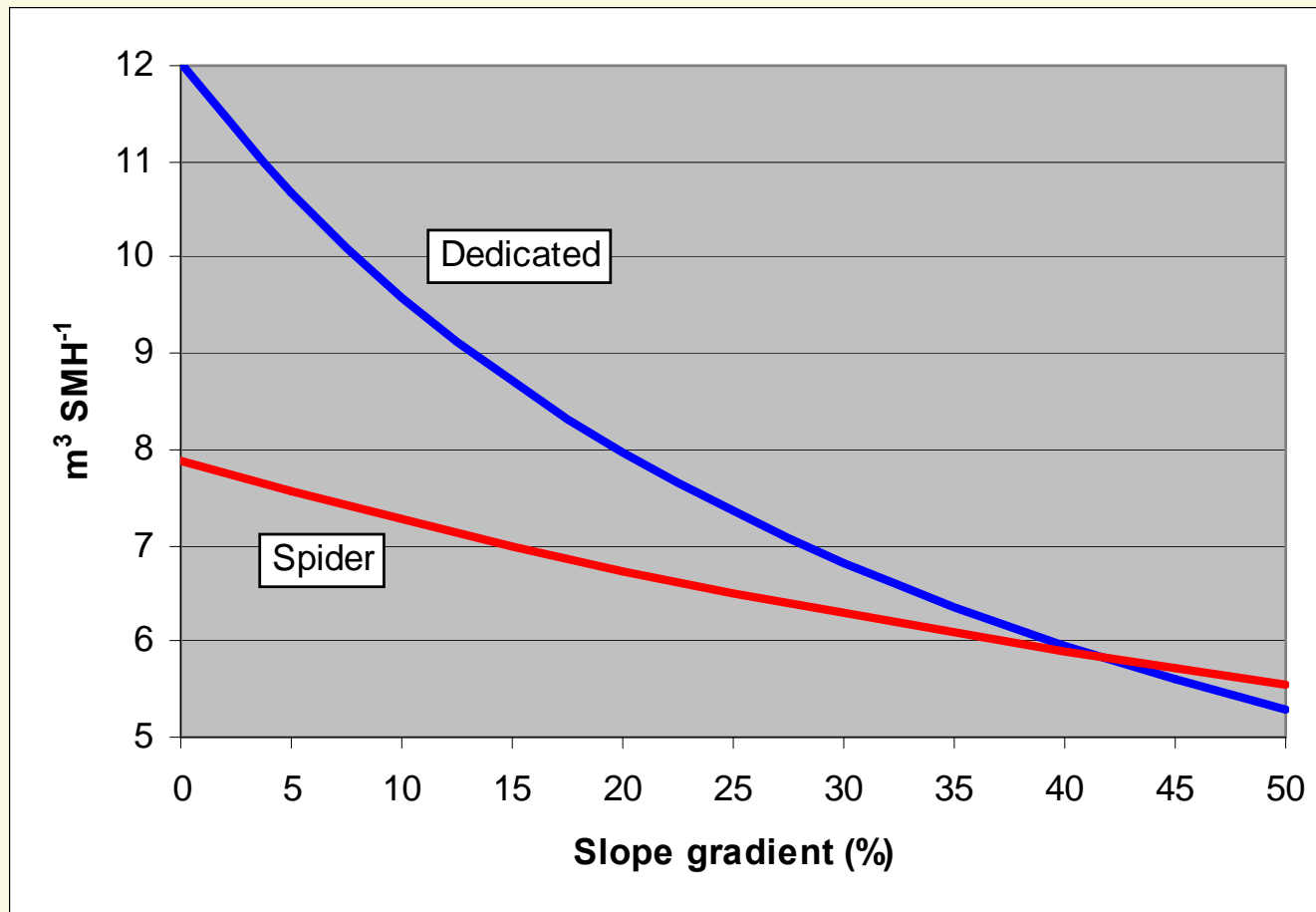


- **Compromise** btw. accuracy & simplicity

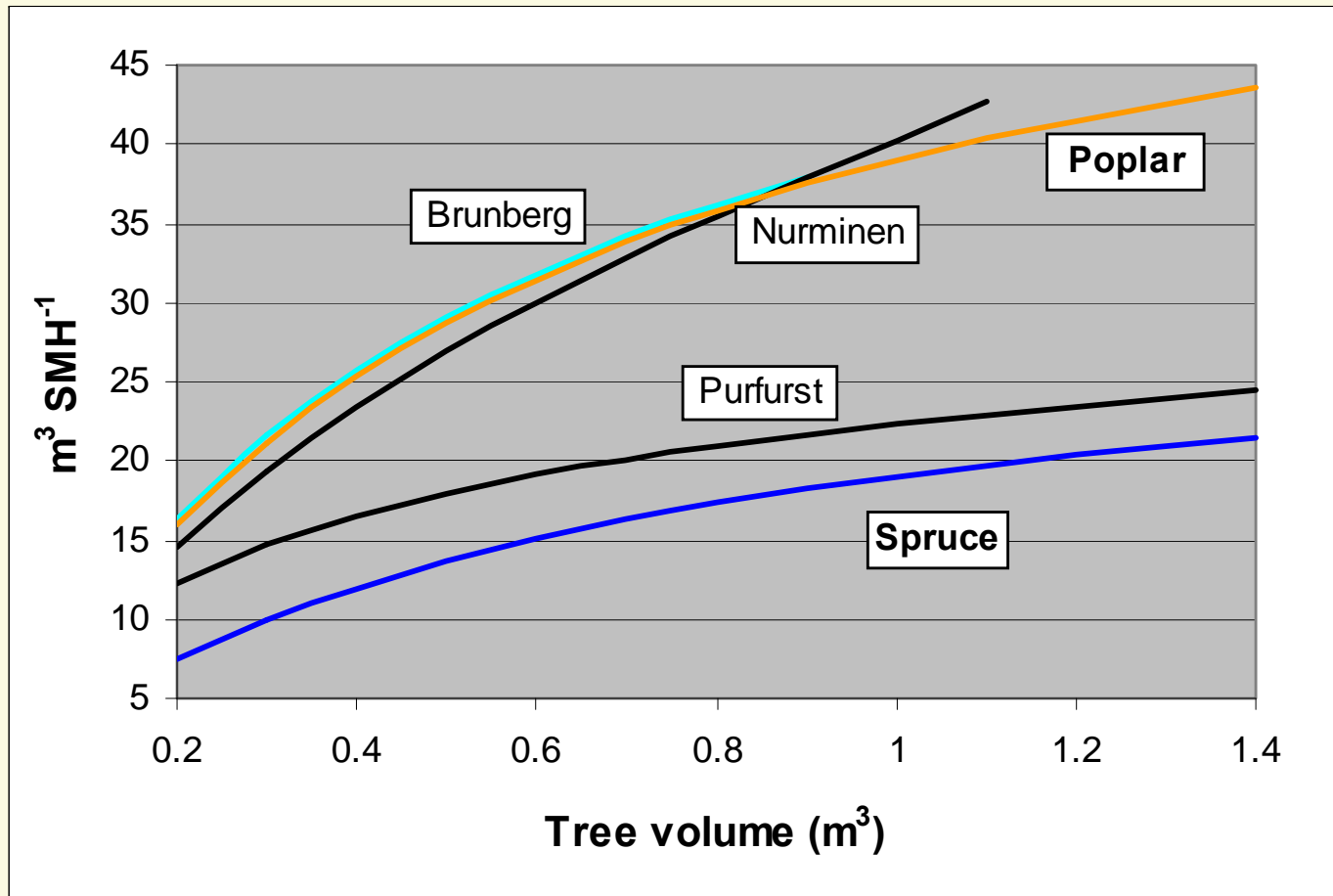
Harvesting productivity



Steep-terrain harvester



Comparison other norms



Conclusions

- Mechanized harvesting established in Italy
- Good body of knowledge
- Base for further R&D

