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Mechanization of French logging operations: challenges and perspectives in 2020

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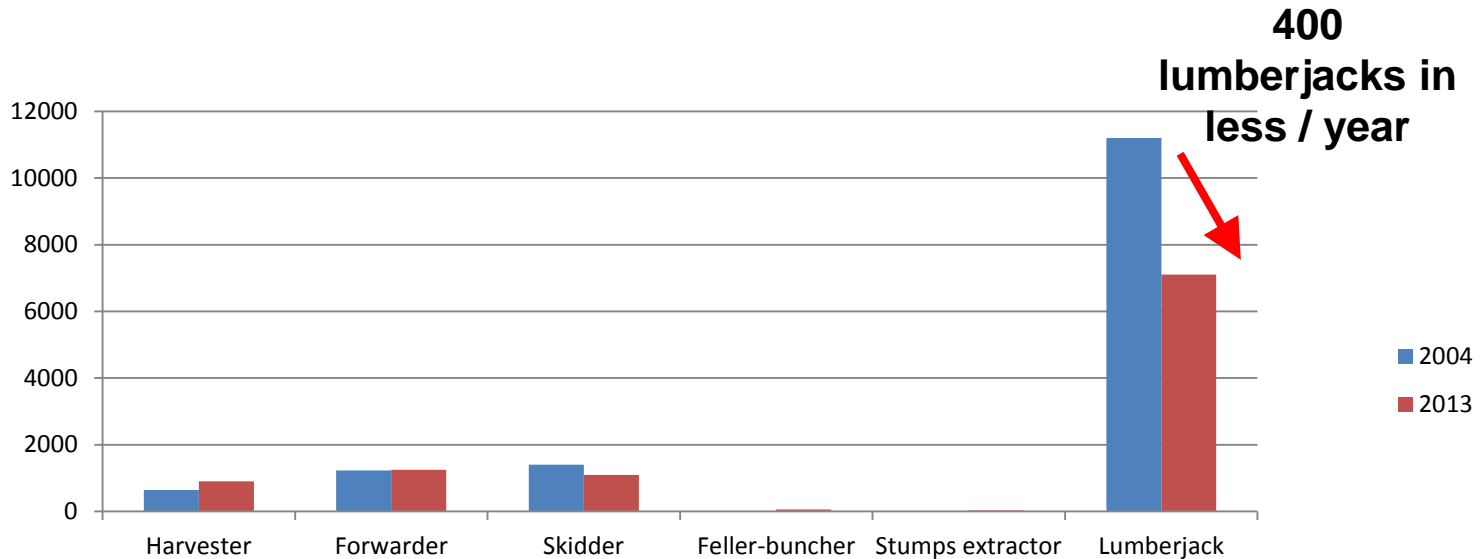
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Context, overview of logging operations in France

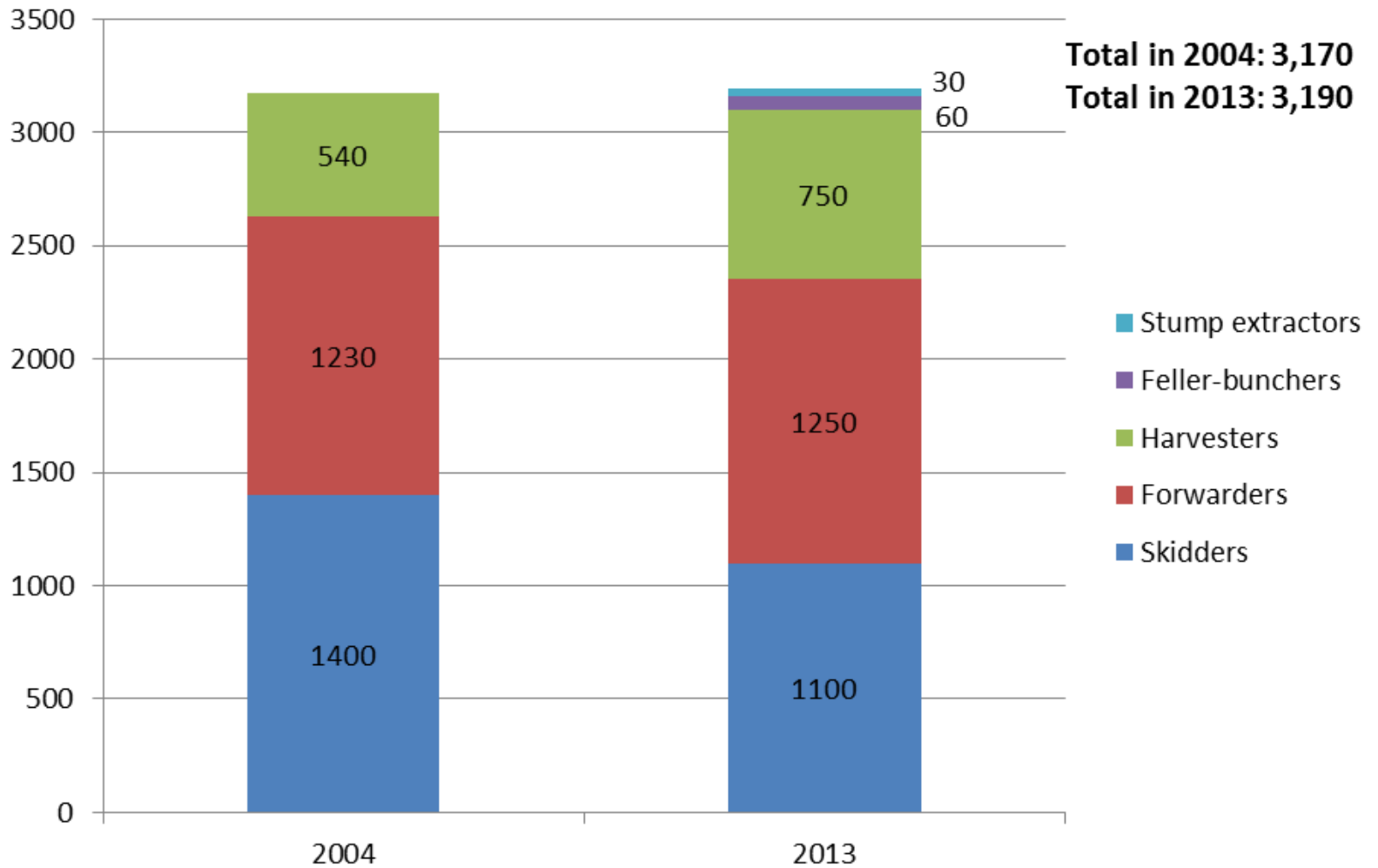
- Manual workforce
- French forest machinery fleet
- Rate of mechanization

Workforce for logging operations in France



Lumberjacks: - 400/year, despite the use of foreign labor
=> 1 Mm³ to mechanize each year (just to maintain annual harvest at the same level)

Evolution and current forest machine fleet



Rate of mechanization in 2013

		1990	1995	2002	2004	2013
Softwood	Nb of harvesters	60	185	500	540	700
	Annual mechanized harvest (Mm ³)	0.5	2.0	8.5	9.2	16.5
	Rate of mechanization (%)	3	9	40	44	80
Hardwood	Nb of harvesters	-	-	30	30	110
	Annual mechanized harvest (Mm ³)	-	-	0.4	0.4	1.5
	Rate of mechanization (%)	-	-	3	3	10
Global rate of mechanization (softwood + hardwood)		1	4	22	24	48

A mechanization which has compensated for the decrease of lumberjacks => **same annual marketed harvest for several years (about 36 Mm³/year)**



Methodology and machines considered for the study

Kind of machines taken into account for this study

- Harvesters used in cut-to-length system, for both soft and hard woods, with or without synchrowinch option (for steep terrain up to 65%)
- Felling heads, with shear or saw disc cutting system, mounted on excavator for whole-tree system and the harvest of wood energy, mainly used for broadleaves in France



Kind of machines taken into account for this study

- Processing heads, mounted on excavators to process trees on the landing site of cable-yarding operations, in steep terrain areas
- Forwarders or small excavators equipped with grapple-saw to mechanize the processing of big broadleaved crowns = semi-mechanized system as felling and a part of processing is made by lumberjacks





Steps of the methodology

- Estimation of expected productivities in 2020
 - Based on current productivity, forecasts and professionals' estimations
- Definition of criteria for (semi-)mechanization
 - What it is "mechanizable" and not
- Calculation of wood resources available in 2020
 - Based on National Forest Inventory's data
- Definition of mechanization scenarios in 2020
 - Current scenario: 45 to 100 new machines/year to compensate the lack of manual workforce and just to maintain annual harvest
 - Various levels of mechanization
- Determination of needed workforce




Results, forecasts for 2020




Evolution of annual productivities (m³/year)

Important gains of productivity: machines more powerful and more reliable, increased size of processed trees...



Machines (annual productivities in m ³)	2004	2013	2020
Harvester (softwood / flat terrain)	17,000	23,500	25,000
Harvester (softwood / steep terrain, with synchrowinch option, slope: 35 to 65%)	-	15,000	17,000
Harvester (hardwood / flat terrain)	12,000	14,000	16,000
Processor after cable-crane	8,000	8,000	8,000
Feller-buncher (shear head)	-	8,500	10,000
Feller-buncher (saw-disc head)	-	-	13,000
Grapple-saw (big broadleaved crowns, flat terrain)	-	8,000	10,000



Productivity gains less important (except for hardwoods): technologic improvements less focused on productivity (ergonomics, computers...), environmental issues, stands more difficult to mechanize...



Criteria of (semi-)mechanization

- Soil bearing capacity:
 - Soil practicable all the year or a part of the year
 - Soil never practicable
- Slope:
 1. < 35%
 2. 35 to 65%
 3. 65 to 100%
 4. > 100%
- Average tree volume:
 - For hardwoods: < 0.5 m³ / 0.5 to 2 m³ / > 2 m³
 - For softwoods: < 2 m³ / > 2m³

=> 13 classes of forest stands according to their degree of mechanization and used machines

Typology of forest stands (1/2)

Classes	Kind of stand	Level of mechanization	(Semi-)mechanized logging systems
1	Practicable / Slope < 35% Small hardwoods < 0.5 m ³	Mechanizable	Feller-buncher or harvester
2	Practicable / Slope < 35% Hardwoods 0.5 to 2 m ³	Non-mechanizable	-
3	Practicable / Slope < 35% Hardwoods > 2 m ³	Semi-mechanizable	Grapple-saw for the crowns
4	Practicable / Slope < 35% Softwoods < 2m ³	Mechanizable	Harvester
5	Practicable / Slope < 35% Softwoods > 2m ³	Non-mechanizable	Chain-saw operator + Skidder
6	Practicable / Slope 35 to 65% Softwoods < 2m ³	Mechanizable	Synchrowinch harvester (or equivalent)
7	Practicable / Slope 35 to 65% All hardwoods and softwoods > 2m ³	Non-mechanizable	-

Typology of forest stands (2/2)

Classes	Kind of stand	Level of mechanization	(Semi-)mechanized logging systems
8	Practicable / Slope 65 to 100% Softwoods < 2m ³	Semi-mechanizable	Chain-saw operator + cable crane or skidder + processor
9	Practicable / Slope 65 to 100% All hardwoods and softwoods > 2m ³	Non-mechanizable	-
10	Not Practicable / Slope < 100% Softwoods < 2m ³	Semi-mechanizable	Chain-saw operator + cable crane or skidder + processor
11	Not Practicable / Slope < 100% Other trees	Non-mechanizable	-
12	All slopes / poplar plantations	Mechanizable	Harvester
13	Slope > 100% / all trees	Impossible harvesting	-



Forest resources available in 2020 (thousand of m³ over bark)

	Saw wood	Pulp and energy wood	Total
Mechanizable	15,755	26,287	42,042
Semi-mechanizable	4,638	7,078	11,716
Non-mechanizable	10,627	15,384	26,011
Impossible harvesting	8	6	14
Total	31,028	48,754	79,782

But these figures don't take into account the structure of the forest ownership and wood suppliers:

- 6% of the availability in small private forests < 1 ha => considered as non-mechanizable and to be deducted from above volumes (all stand classes)
- Self-consumption of 21 Mm³ (fire logs) done by non-professionals and farmers => to be deducted from lowland hardwood stands (stand classes 1, 2 and 3)

=> 39.4 Mm³ mechanizable or semi-mechanizable

Maximum mechanization scenario

- Quite simplistic, considering that everything that can be mechanized or semi-mechanized will be so (39.4 Mm³) => order of maximal machinery fleet
- Nb of machines and investments necessary (does not include renewal of machines):

Machines	Hard-woods	Soft-woods	TOTAL	Additional machines (/2013)	Investment cost (M€)
Feller-bunchers (shear, saw disc)	320	-	320	260	57.2
Harvesters	210	810	1020	270	108.0
Harvesters with synchrowinch option	-	180	180	170	79.9
Processor after cable-crane		240	240	220	44.0
Grapple-saw	550	-	550	540	124.2
TOTAL			2,310	1,460	413.3



Mechanization scenario based on demand of wood industry in 2020

- Volumes harvested in 2020 would be 46.5 Mm³:
 - Sawlogs: 23.5 Mm³ of which 7.5 of hardwoods
 - Pulp wood: 12 Mm³, 50/50 hardwoods/softwoods
 - Energy wood: 11 Mm³ marketed of which 80% of hardwoods (without taking into account 21 Mm³ of self-consumption for fire wood)
- 12 Mm³ handled by lumberjacks (considering 400/year in less)
=> 34.5 Mm³ to (semi-)mechanize (18 Mm³ were mechanized in 2013)
- Distributing these 34.5 Mm³ between the different classes of forest stands, according to their logging difficulties and taking into account the needs for hardwood/softwood and the distribution among saw / pulp / energy wood



Mechanization scenario based on demand of wood industry in 2020

Nb of machines and investments necessary (does not include renewal of machines):

Machines	Hard-woods	Soft-woods	TOTAL	Additional machines (/2013)	Investment cost (M€)
Feller-bunchers (shear, saw disc)	290	-	290	230	50.6
Harvesters	170	770	940	190	76.0
Harvesters with synchrowinch option	-	110	110	100	47.0
Processor after cable-crane	40		40	20	4.0
Grapple-saw	450	-	450	440	101.2
TOTAL			1,830	980	278.8

Realistic for some machines but for others huge gap from current situation



Needed workforce in 2020 (based on the last scenario)

- + 980 machines in 2020 in comparison with 2013 (without machines to renew)
- So 1,040 additional drivers in 2020 (considering mainly single-shift driver):
 - 170 additional drivers / year
 - 240 additional drivers / year taking into account the annual turn-over
- To compare to the 70 graduated new drivers coming out of training centers annually



Recommendations, conclusion



Recommendations, conclusion

- A lot of recommendations dealing with:
 - Training: consolidate the capacities of training centers...
 - R&D: how to mechanize additional resources (slope, hardwood)...
 - Organization of logging operations: increase the utilization rate of machines...
 - Public policies: financial support to encourage structuring forest companies...
- Recommendations partially integrated within national strategies for wood-based industry + specific actions to carry out
- A great challenge remains the human issue: training, attractiveness, ergonomics...



Thanks for your attention!
Any questions?

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