



The 12th World Bamboo Congress

A work efficiency analysis by a modified bamboo harvester for clump bamboo logging

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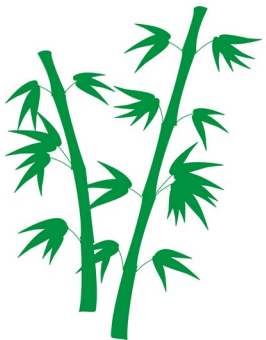
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Apr/20/2024

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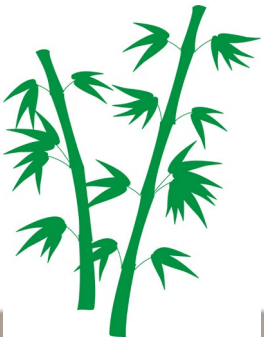
Introduction₋₁

- the sympodial style thorny bamboo (*Bambusa stenostachya*) is main bamboo species and widely distributes in the southern Taiwan (ca 49,000 ha)
- thorny bamboo generally has larger culm diameter (ca. 8-15 cm), longer length (ca. 10-16 m), possesses thick culm wall can be processed maximum
- its texture is tough and easy to use for furniture and construction
- therefore, thorny bamboo provided a huge important economic resource for local bamboo processing industry during the years 1960s-1980s.

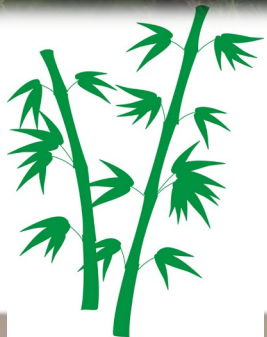


Introduction₋₂

- but, thorny bamboo grows in clusters, the lower half part of the bamboo culm is surrounded by soft incisive thorny branches
- the process to remove thorny branches increases culm logging difficulty and worker injury risk for traditional bamboo logging
- the aim of this study is to promote the clumpy thorny bamboo harvesting efficiency and operating safety through a mature technical timber harvester, and testing its function and operational efficiency
- the study provided a feasible way, to keep developing a high efficiency harvester for clump bamboo logging uniquely



Introduction₋₃

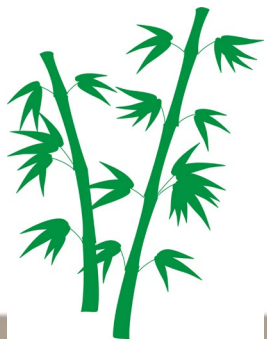


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Materials and methods₋₁

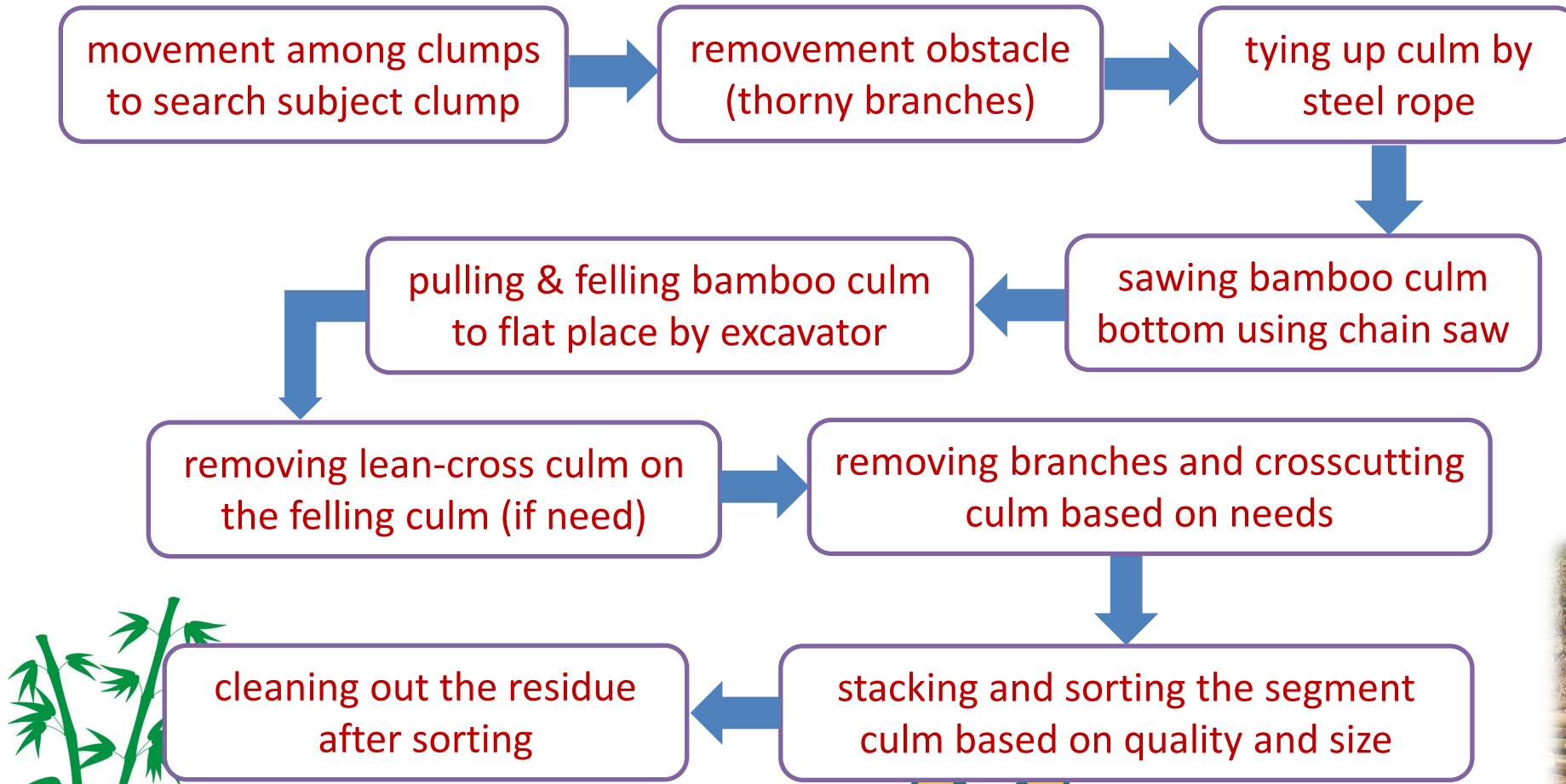
Study sites

Logging method	Region	Location	
Traditional logging	Longchi District, Tainan City	22°56'23.29"N, 120°23'30.8"E	85 m
Modified bamboo harvester	Liugui District, Kaohsiung City	22°58'40.26"N, 120°38'9.3"E	296 m

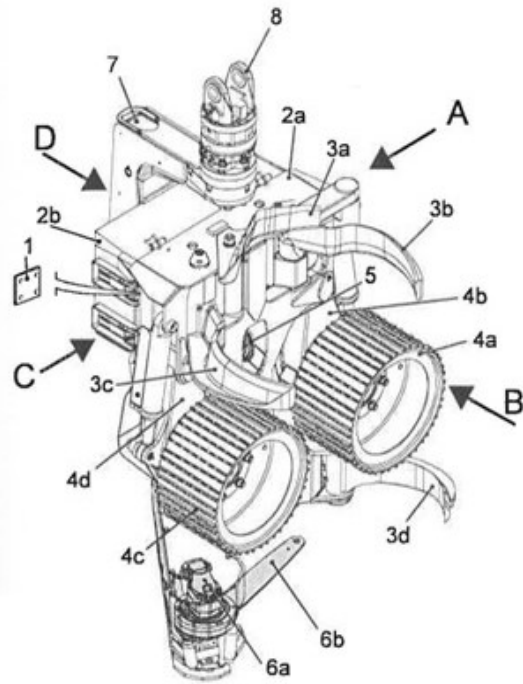


Materials and methods₋₂

The procedure of the traditional clump bamboo logging



Materials and methods₋₃



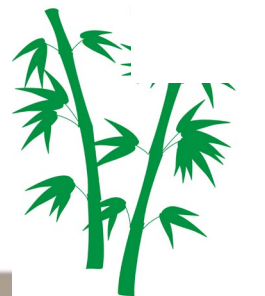
- | | |
|---|-----------------------------|
| A | Left |
| B | Front |
| C | Right |
| D | Rear |
| 1 | Rating plate |
| 2 | Frame with protective cover |
| a | Frame |
| b | Protective cover |
| 3 | Delimiting unit |
| a | Upper delimiting knife |
| b | Left delimiting knife |
| c | Right delimiting knife |
| d | Lower delimiting knife |
| 4 | Feeding unit |
| a | Left feed roller |
| b | Left feed roller arm |
| c | Right feed roller |
| d | Right feed roller arm |
| 5 | Length measurement unit |
| 6 | Saw unit |
| a | Saw motor |
| b | Saw bar and saw chain |
| 7 | Felling link |
| 8 | Rotator |



two main measures were modified:

- **to avoid to scratching on culm surface:** adopting a pair of thick rubber to replace a metal on the feeding roller surface
- **to avoid crushing the hollow bamboo culm:** adapting the pressure of the feeding roller

Harvester main components



Results and Discussion⁻¹

The spending time of each procedure of the traditional clump bamboo logging

Procedures	n	Spending time (sec)	Average (sec)
1. movement among clumps ¹	4	954.2	238.5±120.7
2. removal of obstacle (thorny branches) ¹	4	864.8	216.2±122.2
3. tying up culm by steel rope ¹	6	692.7	115.4±90.2
4. sawing bamboo culm bottom using chain saw ¹	6	1003.3	167.2±112.7
5. pulling & felling bamboo culm to flat place by excavator ¹	6	711.5	118.6±45.9
6. removing lean-cross culm on the felling culm ¹	6	293.1	48.9±20.1
7. removing branches and crosscutting culm based on needs ²	40	7655.4	169.1±107.1
8. stacking the segment culm based on quality and size ²	40	2513.5	61.8±15.2
9. sorting out the residue after stacking ²	35	1326.5	37.8±11.9

Note: ¹ means the procedures steps were taken the movement among bamboo clumps.

² means the procedures steps were handled the individual culms after logging from clumps.



Results and Discussion₋₂

The time rate comparison of two processing of the clump bamboo logging

	the traditional clump bamboo logging		the modified bamboo harvester	
Procedures	Average (sec)	Rate (%)	Average (sec)	Rate (%)
pre-processing	114.5±33.4	31.1	138.5±46.7	70.6
post-processing	287.4±125.5	68.9	57.8±21.3	29.4
Total	401.9±154.6	100	196.3±114.3	100

The other comparison of two bamboo logging approach

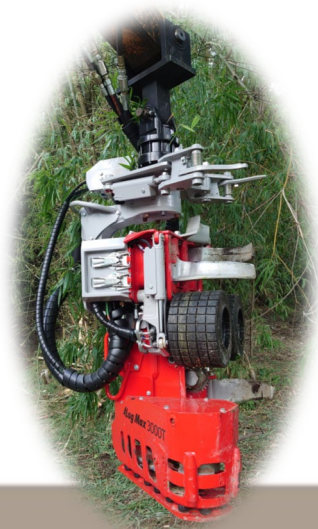
Approach	Worker number	Work time limitation	Logged culm number estimation
Traditional bamboo logging	2	4 hrs	1432 culm
Modified bamboo harvester	1	7 hrs	5390 culm

Note: the modified bamboo harvester provides safety protection to the operator, decrease injury during the logging processing



Conclusion

- with technique modified, a mature timber harvester can converted to a flexible bamboo harvester on clump bamboo logging
- the modified bamboo harvester provide a promotion on work efficiency to clump bamboo logging
- the modified bamboo harvester provides great safety protection to the logging worker, decrease injury during the logging processing



Acknowledgment

The authors gratefully thank the Taiwan Forestry Research Institute, Ministry of Agriculture, Taiwan, for financial support through project grants 112AS-7.4.1-FI-G2.



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*Thank you
for your attention*

