Mechanical Tea Harvesting: Bridging Science and Practice in the Tea Sector

Brewing Innovations
1925 | TRI | 2025

Tea Research Institute of Sri Lanka

Introduction, Scientific Facts, and How to Improve

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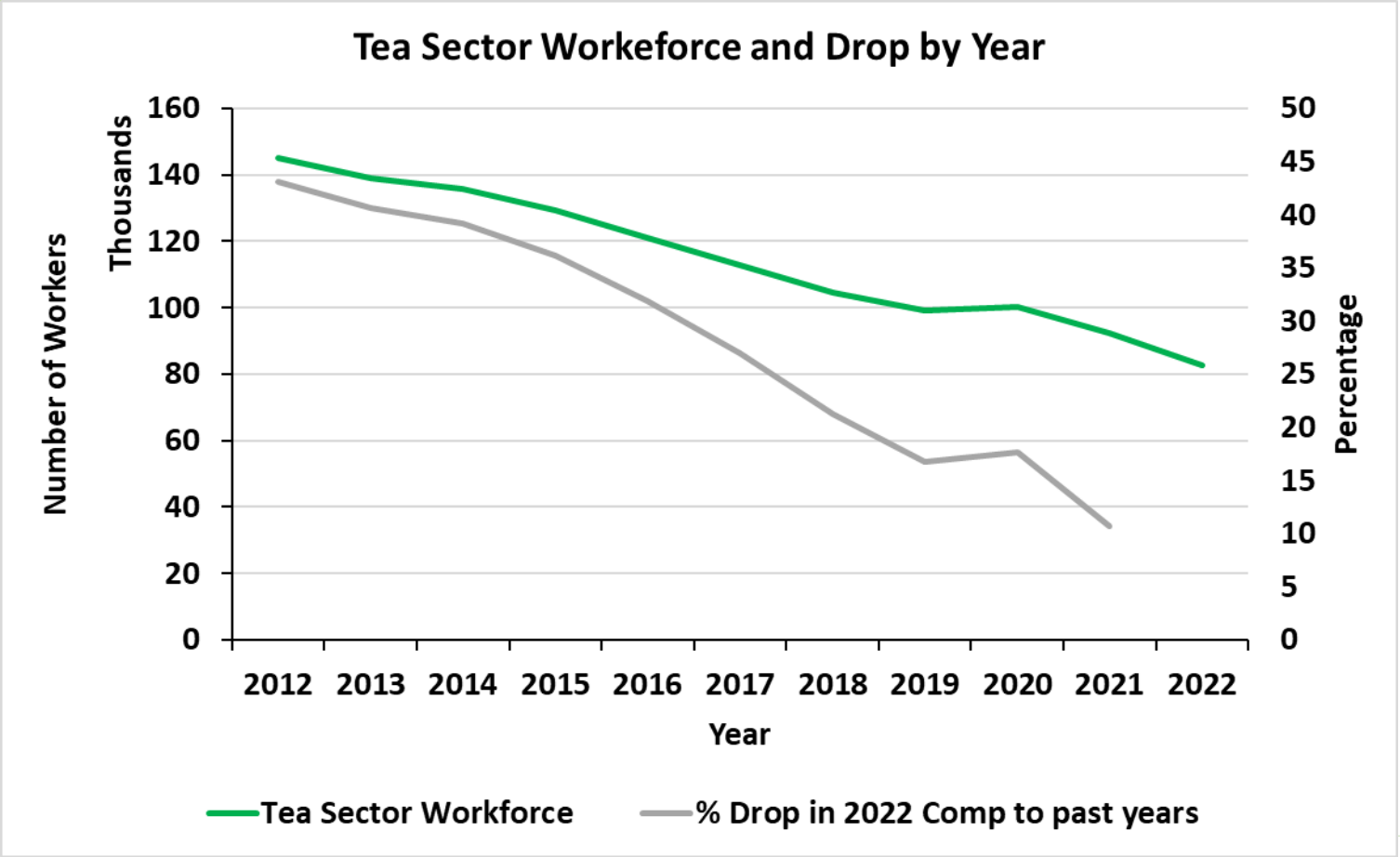
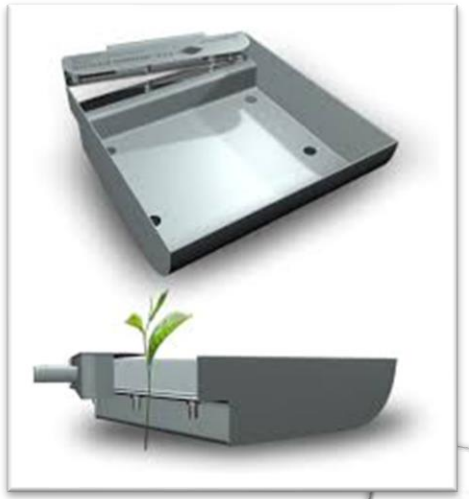
Introduction

- Why we need machines
  - Labour shortage – Workers shift to other industries
  - Labour intensive field operations (plucking / pruning / holing)



Mechanical harvesting of tea



Use of shears for tea harvesting

	TRI selective harvesting shear (TSHS)	Other shears with long handles
Output (kg/day)	30-50	25-40
Over-mature parts	Negligible	10-15%
LPH*	6-7	10
		

Fresh flush (kg/day)	60-200	(Manual – 20-25)
Over-mature (maintenance foliage)	5-10%	
Ha/day	0.2-0.8	(Manual 0.1: 10 LPH)
Fuel (Litres/day)	3-4 (depends on working hours, bush stand, weather, operation, etc.)	

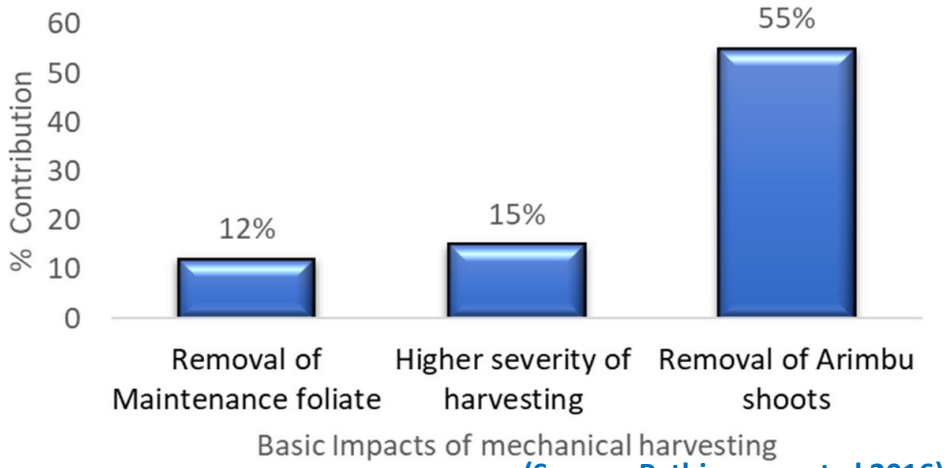
(12500 bushes per ha & 6.5 working hrs)

Constrains in Motorized Machines

- Crop loss in continuous usage (Quantitative losses compared to *manual selective 7-day* rounds)
- Weakening of bush health in continuous use
- Over-mature parts in harvested crop (qualitative losses)
- Difficulty to use on slopes
- Obstacles in the field (drains, shade trees, etc.)
- Need of trained labour
- Capital and maintenance costs
- Price of fuel

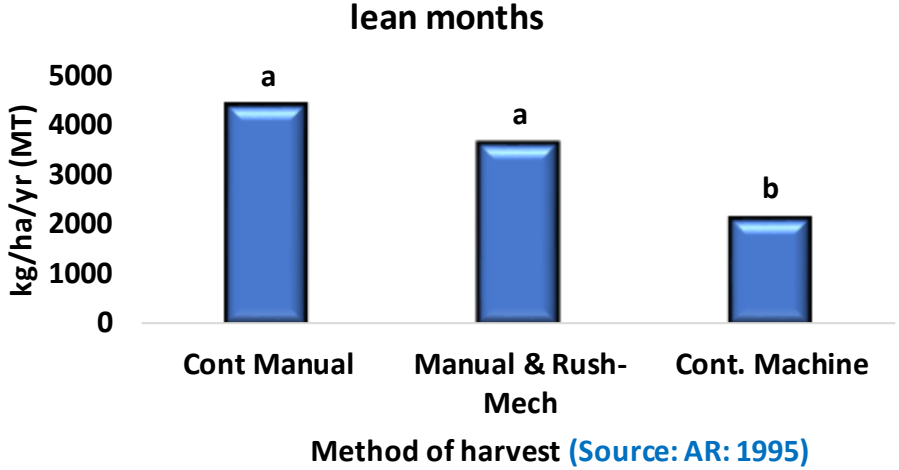
Minimizing practical Issues – Experimental facts

1



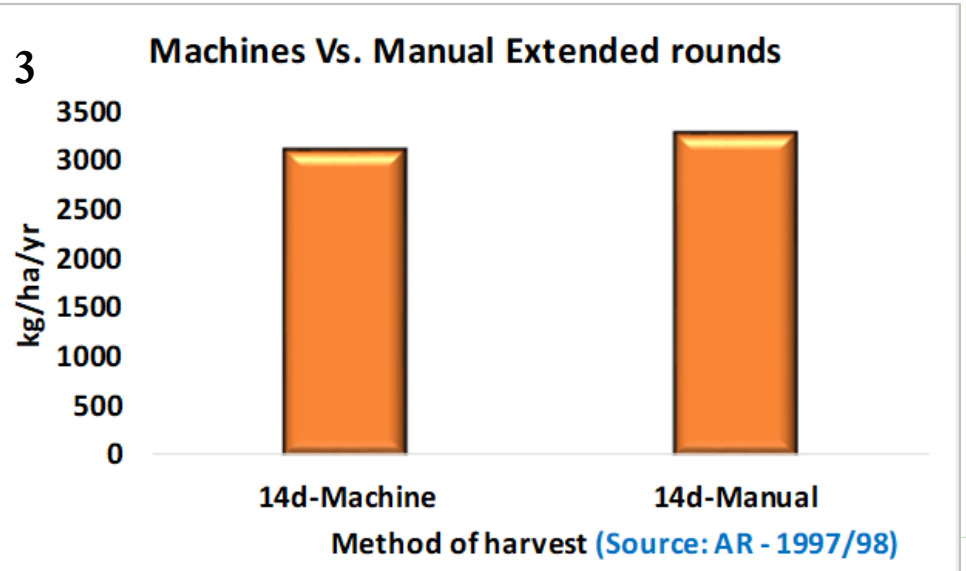
(Source: Pathiranage et al 2016)

2



(Source: AR: 1995)

3



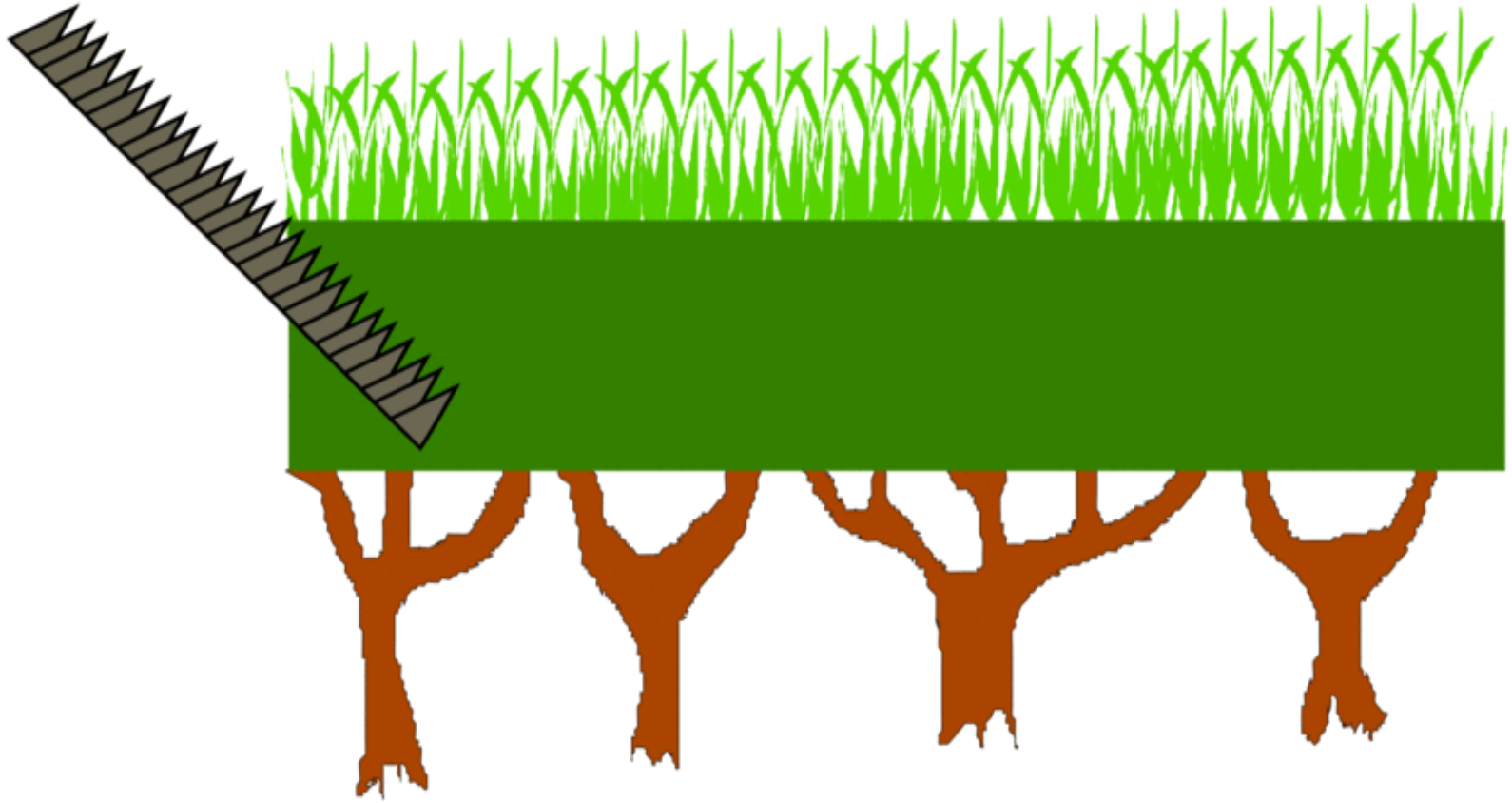
(Source: AR - 1997/98)

1. The main cause of yield reduction is removing Arimbu shoots. Therefore, DO NOT cut deep into the table.

2. Using machine only during rush crop doesn't drop the yield, if labour shortage is not too severe

3. Tea yield in manual delayed rounds and mechanical harvesting showed no considerable difference.

Practical approaches to minimize problems



OK

Avoid repeatead cuts

Do NOT Cut Deep

Practical approaches to minimize problems

OK

Avoid repeatead cuts

Styles of machine operation on the table

Straight run

- High speed of operation
- More suitable for flat tea lands

Styles of machine operation on the table

Scrape back

- Scraping action towards the operator
- Suitable for tea lands with a slope

Estate Machinery Today

Battery tea harvester

Petrol Operated Harvester

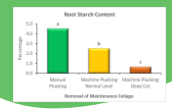
	Battery Harvester	Petrol Operated Harvester
Number of Operators	Single man / Single hand operation	2 men operated
Cutting mechanism /Selectivity	Hair-Clipper type sharp blades Non-selective	
Weight	1.2-2.5 (Harvester) 1.5-2.5 (Battery)	4.5 kg (Harvester) 5.5 kg (Engine / 2-stroke/ 20+ CC)
Power Source (day=6.5 working hrs)	Battery (24V or more / Li-Iron) Run time 3-12 hr (model matters)	Petrol/2T 3-4 L/day
Cutting Width	30 cm	60 cm
Output (depends on available shoots to cut)	80-120 kg/day	100-200 kg/day
Land Coverage	About 0.2 ha/day	About 0.5 ha/day
Coarse leaf content (in correct operation)	<10% (needs sorting out before processing)	
Remarks	• Many suppliers /Slight differences • No collecting bag supplied • Comparatively less durable and cheep	• Needs periodic servicing / Repairing • Comes in a full-set • Comparatively durable but expensive

Common Mistakes by Operators

- Cutting same plucking points more than once
- Cutting too deep into the table
- Do not sort out coarse leaves

Removing Maintenance Foliage

- Higher coarse leaf % in harvest (quality)
- Delays shoot regeneration
- Very thin maintenance foliage layer (<1-2”) → Photosynthesis
- Both qualitative and quantitative losses
- Hight stress / Low bush health
- More damages to rotorvane (manufacturing)

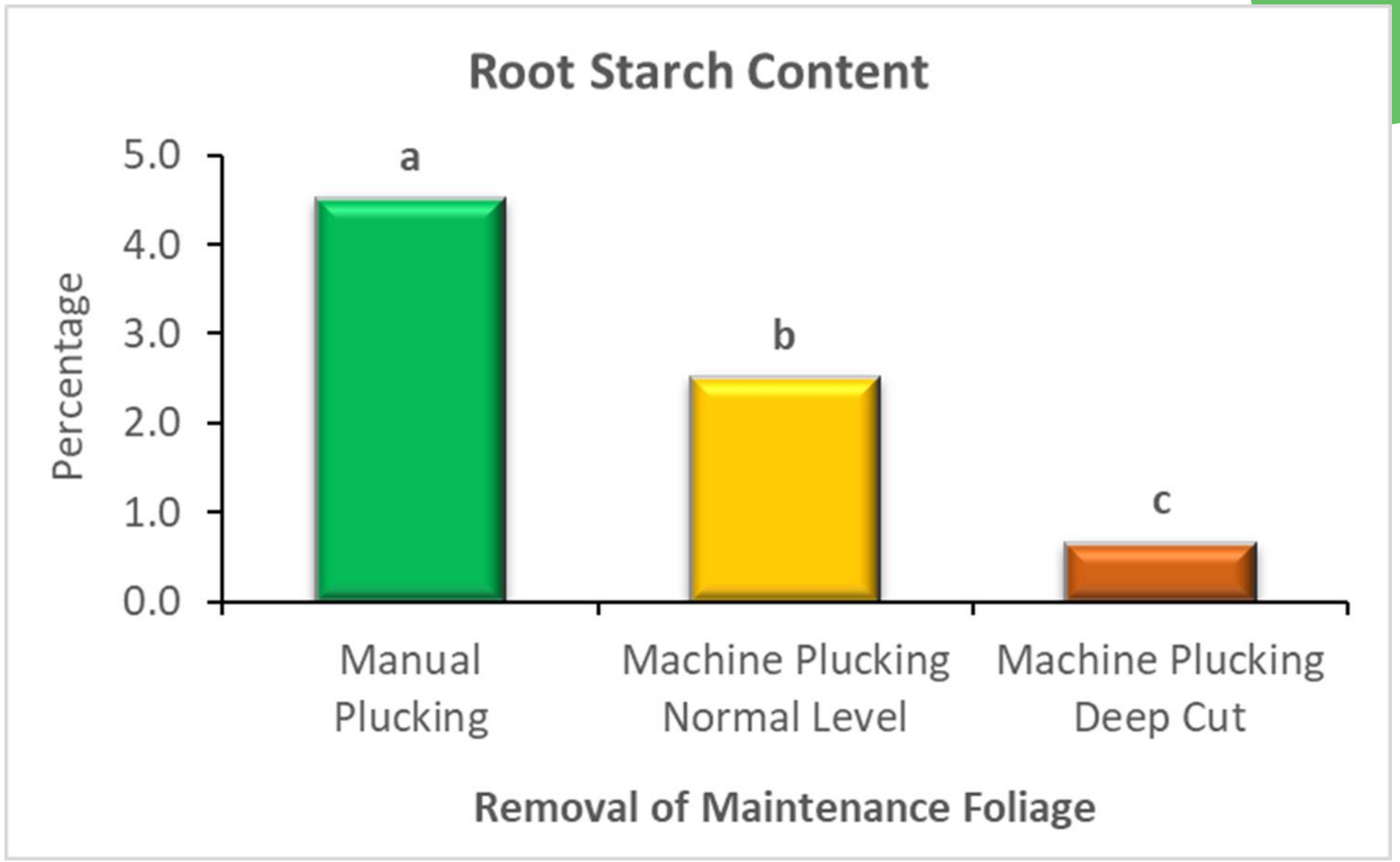


Very deep cuts to the red-wood

No maintenance foliage

No maintenance foliage

Very deep cuts to the red-wood




Less Severe Plucking

Less severe machine harvesting

Better maintenance foliage layer

Tips to Improve

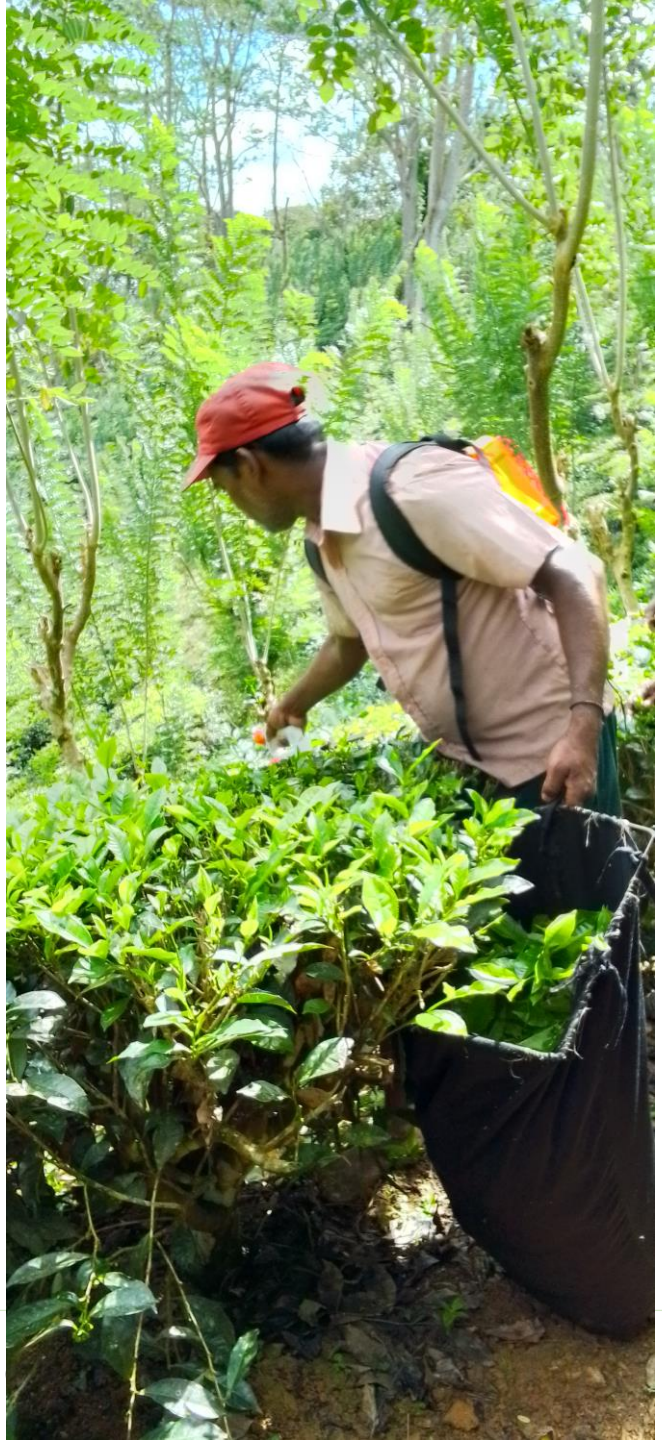
For Both the machines

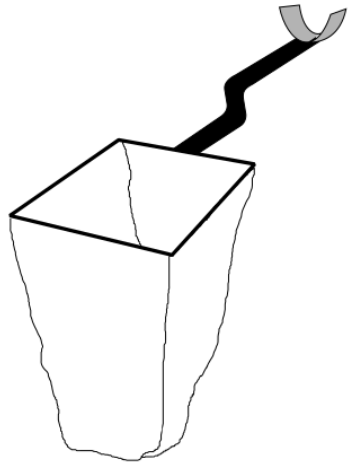
- Never cut deep into the table
- Avoid repeated cuts on same plucking points
- Sort out over mature parts before processing

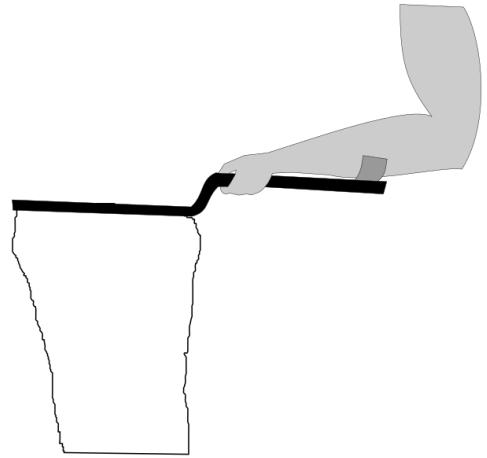
- Level the table at the beginning if necessary
  - Not in every plucking round

For Battery Operated Machine

- Cloth bags are better than trays
- Maintain swing speed to collect cut shoots
- Hold the bag same level to the plucking table







Weight bearing and handling will be easier

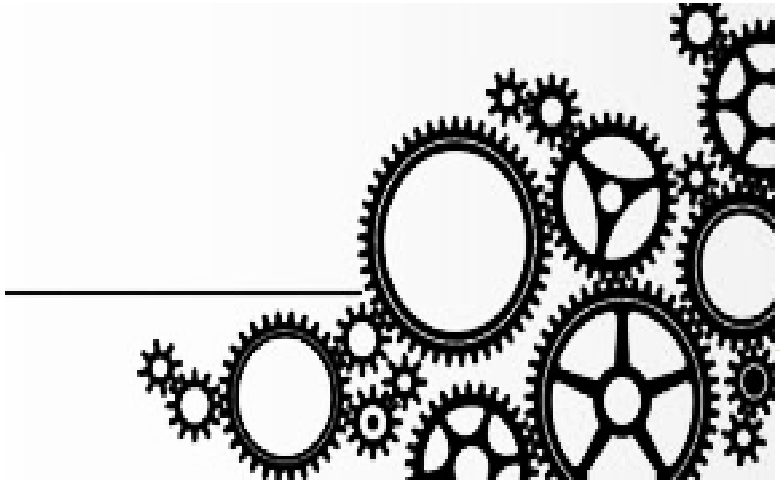
Benefits of using plucking machines

- An effective strategy for worker shortage
  - Manage task with the existing workers
- Any abandoned fields taken back into plucking
- Intact green leaves
  - Quality better than in extended manual rounds
- Fosters Positive attitude towards new technology
  - Brings back youth into plantations
- Reduces cost of harvesting

- No injuries to fingers
- Increases worker income
- Self satisfaction with Job/Social recognition

Practical Perspectives on Mechanical Harvesting

T G N Mahinda



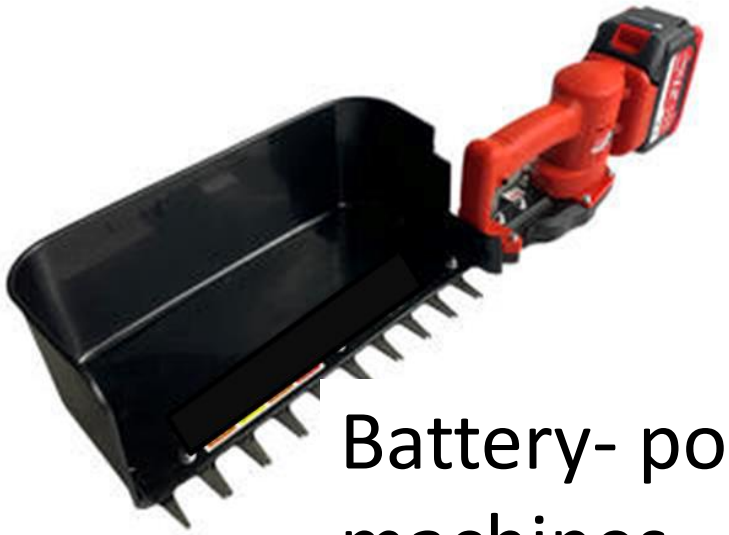
A case study based on field observations and secondary data

Objective	To explore operators' daily output, plucking intervals, monthly earnings, costs, daily norms and factors driving adoption of mechanized harvesting in corporate sector tea plantations
Methodology	Cross-sectional case study
Population	Corporate sector tea plantations
Data collection	Qualitative and quantitative data + secondary data
Data analysis	Descriptive and thematic analysis

	Basic information		
Site	**Geographical location**	**Extent**	**% Mechanized extent**
Case A	Up country (above 1250 MSL)	230.9 ha	100%
Case B	Up country (above 1250 MSL)	230 ha	53%
Case C	Up country (above 1340 MSL)	319 ha	3%*
Case D	Up country (above 1280 MSL)	408 ha	25%

Harvesting devices used at visited locations

Shears(Selective tea harvester)

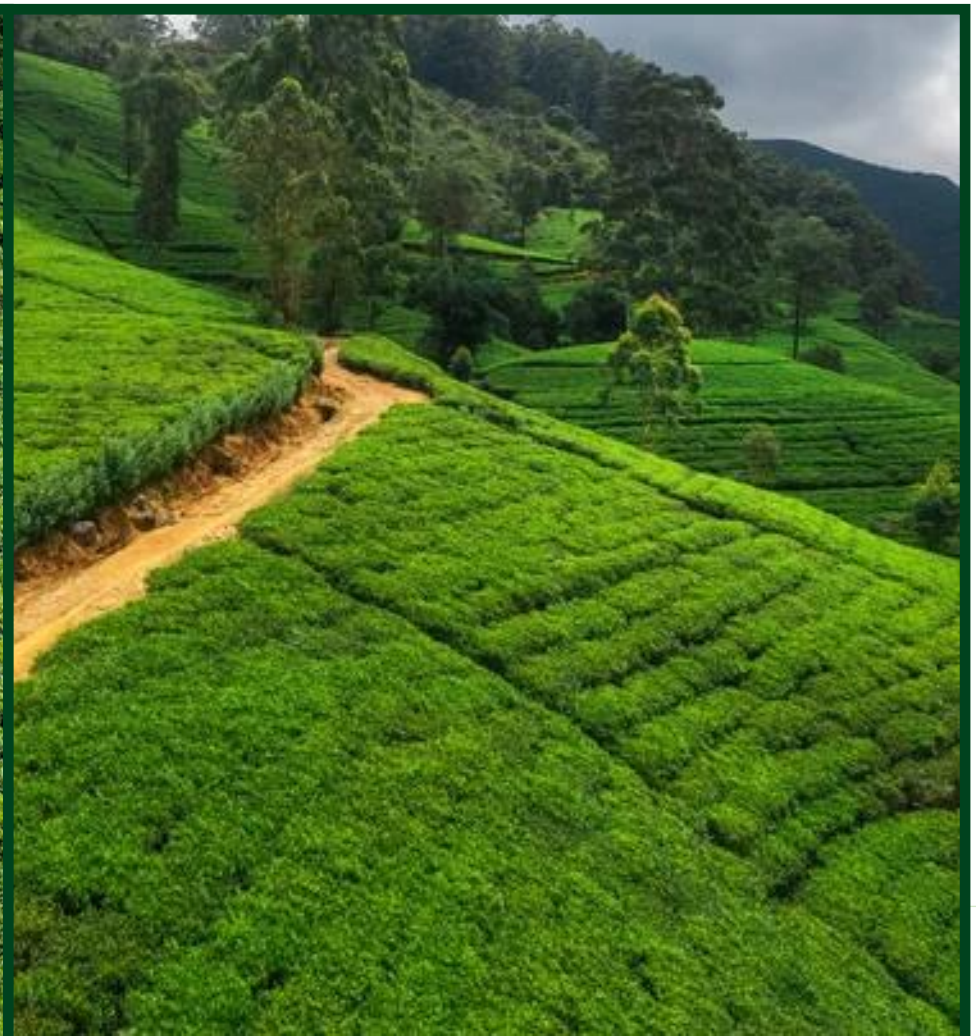


Battery- powered machines

Fuel- powered machines (Two people)

Fields Where Mechanical Harvesting practiced

Existing VP tea fields /Seedling fields (A, B & C) (Mostly B &C)

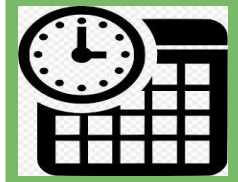


An overview of the site visits (2024) (a)

	Item	Site A	Site B	Site C	Site D
1	 Worker shortage 10 yrs (2015-2024)	35%	39%	40 %	53%
2	 Machines used	(S) Shear (F) Fuel	(B) Battery (F)	(B)	(B)
3	 Mechanically Harvested extent	(S) 75% (F) 25%	(B) 53%	(B) 3%	(B) 25%
4	 Duration of MH	(S) 13 yrs (F) 4 yrs	(B) 1 yrs (F) 4 yrs	(B) 8mth	(B) 1 yrs
5	 LPH	(S) 10 (F) 8 (4x2)	(B) 6 (F) 8 (4x2)	(B) 5	(B)6
6	 Harvesting Cost for 1 Kg of made tea (Rs.)	(S) 325 (F) 220	(B) 220 (F) 230	-	(B)184

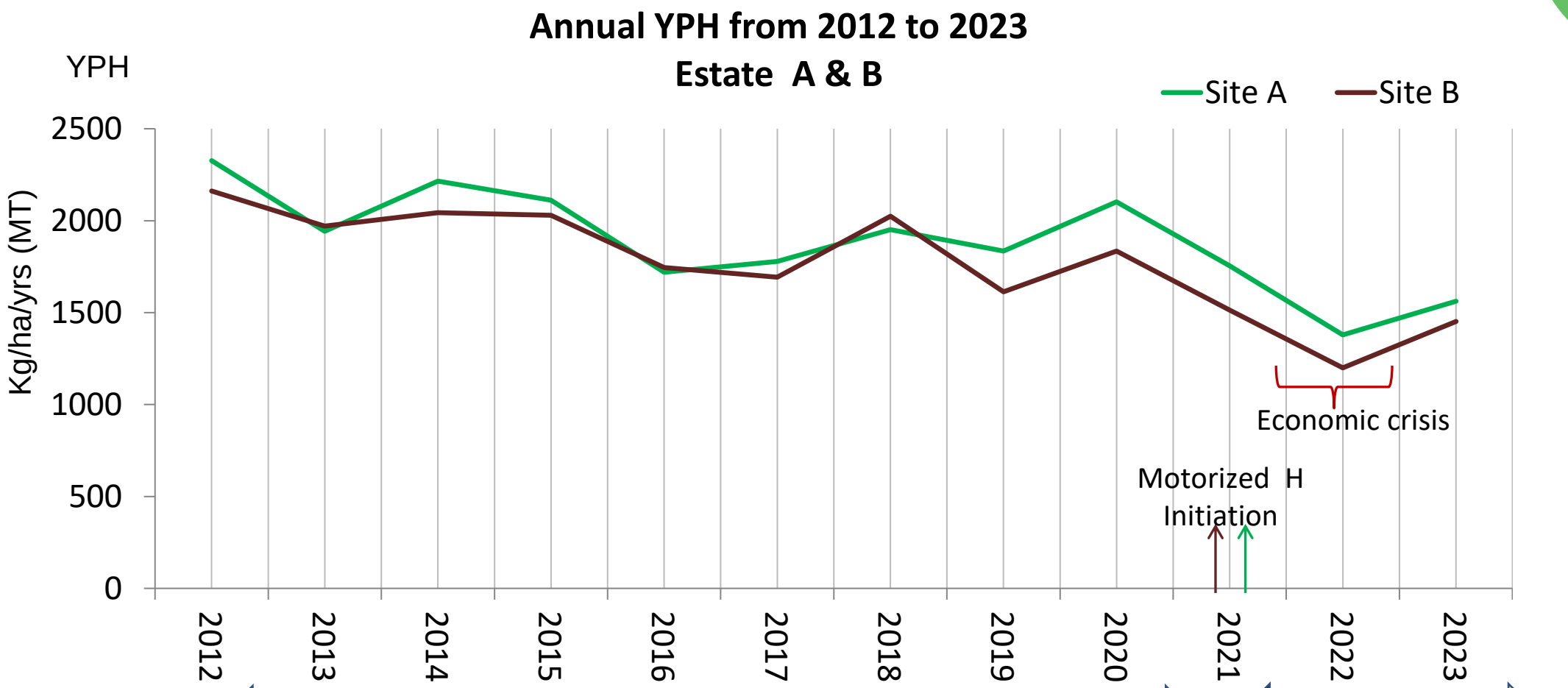
LPH- Labours per Hectare, **Yrs-** Years, **mth**- Months,
(S) Shear **(F)** Fuel-powered machine, **(B)** Battery-powered machine

An overview of the site visits (2024) (b)

	Item	Site A	Site B	Site C	Site D
1	 Operators' daily norm (Kg)	(S) 20 (F) 40x2	(B) 30 (F) 40x2	(B) 20	(B) 40
2	 Average plucking round/mth	(S) 2 - 3 (F) 1.5 - 2	(B) 2 (F) 1.5 - 2	(B) 2	(B) 2
3	 Operators' daily average output (Kg)	(S) 29 (F) 112(56x2)	(B) 45 (F) 110(55x2)	(B) 50	(B) 38
4	 Operators' average monthly earnings	(S) Rs. 39,300 (F) Rs. 54,000	(B,F) Rs. 57,300	Rs. 70,000	Rs. 40,675
5	 Average refuse tea %	(S) 12% (F) 22%	(B+M+F) 21%	(B+M) 13%	21%

(S) Shear **(F)** Fuel- powered **(B)** Battery -powered **(M)** Manual **mth**: months

Annual YPH (Over ten years)



Field observations

Severity of harvesting- High

Potential plucking round: n ≤1

Severity of harvesting- less

Potential plucking round: n ≥ 2

Summary of Findings

Harvesting method → / Item ↓	Shear	Fuel powered	Battery powered	Manual
Average norm (Kg)	20	40x2	30	20
Average harvest(Kg)	29	110 (55x2)	44	
Average plucking round/month	2-3	1.5 -2	2	-
Average monthly earning(Rs.)	39,300	55,650	56,000	
LPH	10	8 (4x2)	6	12
Harvesting Cost /Kg of made tea (Rs.)	320	225	202	375
Average refuse tea %	13%	22%	22%	11%
*Practice of mechanization in revenue share model – (site: B)				
*Manual harvesting in high yielding area (A & B category fields)- (site: B, C, D)				
*Benefits of motorized Harvesting: Satisfactory monthly earning, No discomfort from finger splits or cracks (Site: A, B , C & D)				

Factors that could enhance the adoption of MH

Skill development of operators (Male & Female)
Sharing **evidence of success stories**
Easy access to **reliable machine repair**/ service centres
The affordable machine price

Facilitation

Facilitated by Extension Team

Fostering **positive attitude** (all categories)
Desire to practice mechanized harvesting
Economic **benefits** to the workers

Personal factors

Feasibility of technology
Usefulness and **Ease of use**

Technical factors

Facilitated by R & D

Adequate foliar and ground **fertilization**
Pruning cycle **adjustment**

Crop-factors

Perception of higher management on MH
Companies policies on worker shortage and cost

Organizational factors

Facilitated by the higher management

(Mahinda et al.,2024)

Suggestion for better adoption of MH

From the practical perspective,

- **Setting up residential skill development training** in a progressive practice environment.

  Well-trained operators can share their experience with trainees in this setup.

- **Initiation of reliable machine repairing centres** at the regional level
- **Mechanization promotion** through evidence of its success

From the scientific perspective,

While practicing;

- Use machines only if the worker shortage is severe.
- Avoid repeated cuts and deep cutting into the plucking table.
- Adhere to GAP to minimize the mechanical stress

Acknowledgments

We would like to express our deepest gratitude to

Mr. V S Athauda, Mr. K Roshan, Mr. Ravindra Sannasuriya, Mr. R Sriganeashan, Mr. V Sujeve Kanna, Mr. R. Thivviyan, Mr. M F A Qadir of corporate sector plantations

THANK YOU !

For Listening to this presentation

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