SMALL HOLDER COTTON MECHANISATION: BANE OR A BOON

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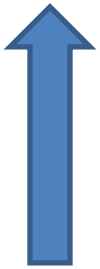
CICR
ICAR - Central Institute for Cotton Research
(An ISO 9001:2008 Certified Organisation)

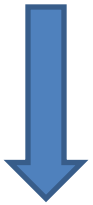
Why machines ?

Labor

Cost



Availability



Average Farm Size and Method of Harvesting

Country	Farm Size (Ha)	Harvesting %	
	2013/14	Hand	Machine
Argentina, Chaco	26.0		75
Chad	1.0	100	
China, Yellow and Yangtze	0.3	99	
Colombia, Cordova	11.5	65	
Greece	5.3		92
India	1-2	100	
Mali	2.9	100	
Pakistan, Punjab	4.0	100	
Spain	10.9		95
Turkey, Aegean	6.0	100	
USA	346-584		100
Brazil	3300		100
Australia	1800		100

Source : – *THE ICAC RECORDER, International Cotton Advisory Committee, Volume XXXII No.4 , Page No.7.*

32.5 M Ha

¾ Hand Harvested

Cotton Statistics : India

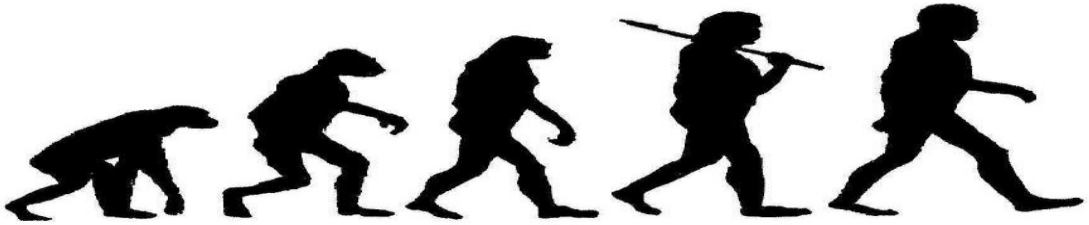
12 million hectares

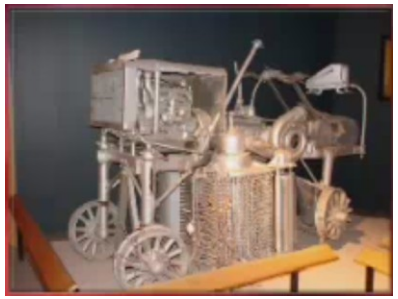
6.4 million farms

¼ < 1 hectare

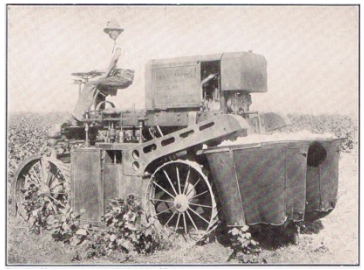
½ < 2 hectare

Avg. 1.5 hectare





Rembert-Prescott 1850



Price-Campbell 1924

1941-42
25 machines sold by IH

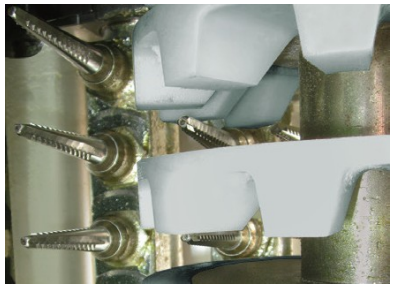
<u>1944</u>
Drying & Cleaning machines developed in anticipation of a machine picker

Vaccuum
Threshing
Electrical
Spindle

1929
Stock market crash
Great Depression

Bottlenecks to mechanical harvesting

- Land holding
- Cost
- Complex, Adjustments : Skillset
- Spares, Repair, Maintenance
- Trash content in Machine harvest
- Multiplicity of varieties



Design intent of a harvester for small farms

- ✓ Low cost
- ✓ Simple construction, operation and maintenance
- ✓ Trash within acceptable limits

2012-14

2 Wheel Tractor Cotton Harvester with Pre-cleaner

Patent filed for a Small cotton harvester With Pre-cleaner attachment by CICR

- Trash content 24% seed cotton basis
- Of the total trash in harvested cotton, the burrs and sticks alone constituted 70-80%
- Incorporate an extensive On-board Cleaner.
- Power and space constraints
- Blower capacity insufficient

2014-16

Development of a Tractor Mounted Cotton Harvester (ICAR-CICR-CIRCOT-Mahindra)

- Tractor mounted finger type cotton harvester (55 hp)
- Conveying system- Belt with flight type (Under side flow)
- Bigger storage tank

On board field cleaner

- On- board field cleaner- Width 600 mm
- Throughput Capacity ~2000 kg/h
- Weight ~750 kg

Slotted sheet base for trash removal

Field Capacity of Harvester vs Manual picking

	Manual Picking (Woman Hrs/ha)	Machine Picking (Hrs/ha)
Time taken to pick 1 ha	454.9	1.49
Idle time for unloading etc.	113.7	0.51
Total time taken for picking 1 ha	568.6	2.00

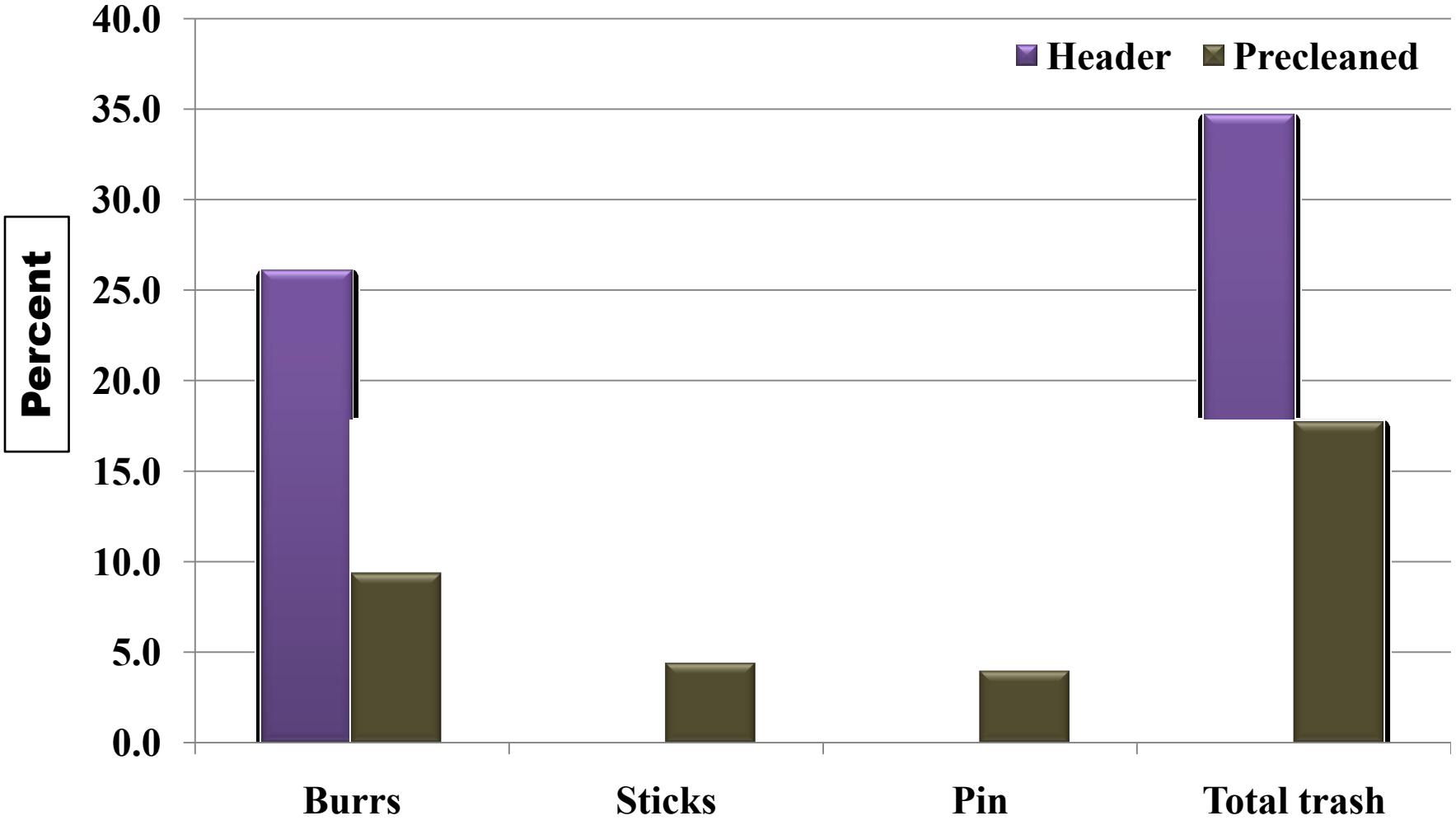
Losses and picking efficiencies

Picking efficiency	% bolls picked		97.9
Header + Cleaner + Shattering Loss	% of Seed - cotton	16 mm comb spacing	11.5
		18 mm comb spacing	12.5

Losses through Header

Trashes from Onboard cleaner

On board Cleaner Efficiency



2016-17

Development of Brush type cotton stripper

- **Finger Type stripping caused plant uprooting, high trash collection**
- **One time harvesting**
- **Brush Roll Type stripping: Employed for over 25% cotton harvesting in US**
- **Suitable for even shorter Plant height 2 – 3'**
- **Reduces input trash at Header itself**

1-Row commercial spindle type Cotton Picker

- One season: 250 acre harvesting, high leaves, green bolls, high initial investment and maintenance cost

Cotton field before harvesting

Cotton Row after harvesting

Fibre Properties of Finger and Brush Stripped Cottons

Field	Cotton Type	UHML mm	UI %	MIC µg/inch	Tenacity (g/tex)	EL %	SFI %
E-11:	Hand picked	29.4	81	4.2	28.7	4.8	7.8
	Finger Header	29.8	82	4.2	28.6	4.9	8.0
	AFC#	29.7	81	4.1	28.3	4.8	8.0
E-12:	Hand picked	30.4	83	4.3	25.4	4.7	6.9
	Finger Header	30.1	82	4.1	25.1	4.8	6.9
	AFC	29.8	83	3.9	27.8	4.8	6.6
A-4:	Hand picked	30.7	86	4.3	28.0	5.1	5.3
	Brush Header	30.4	85	4.2	28.3	5.1	5.1
	AFC	30.6	86	4.3	28.5	5.1	5.3
A-3:	Hand picked	29.1	84	3.8	26.0	5.6	6.5
	Brush Header	29.2	84	3.9	26.5	5.6	6.5

AFC After Field Cleaner

Trash Analysis of Finger and Brush Stripped Cottons

Fields	Harvesting Method	Bracts	Sticks	Green Leaves	Dry Leaves	Green Bolls	Green Grasses	Tot. Trash (SC)
E-11:	Finger Header	23.9*	5.1	1.0	4.6	5.6	1.6	41.8
	AFC	17.9	2.9	2.6	4.4	0	0.6	28.4
E-12:	Finger Header	24.1	5.6	1.2	4.2	4.8	1.3	41.2
	AFC	21.8	3.1	1.5	2.6		0.1	29.1
A-4:	Brush Header	7.4	3.0	1.6	3.2	0	0.3	15.5
	AFC	7.0	1.4	0.5	1.8	0	0.1	10.8
A-3:	Brush Header	9.2	3.5	1.8	3.9	0	0.1	18.5
	AFC	8.8	2.4	0.2	1.1	0	0.04	12.5

Cost of operation

	Manual Picking	CICR Harvester
Expected Cost		**$6,060 with prime mover**
Time taken hrs/ha	**40 women days/ha**	**4.18**
Cost of picking – $/kg (Yield 20Q/ha)	**0.076**	**0.018**  **0.056**
Cost of picking – $/ha	**151.51**	**36.45**  **112.12**

HARVESTER FEATURES

	CICR HARVESTER	1-ROW COMM PICKER
Initial Cost	Lower	Higher
Operation	Simple	Difficult
Row spacing	Any	Only wider rows
Technical skill of operator required	None	Highly trained operator required
Maintenance	Low	High
Spares	Available	Not available
Special chemicals required	Defoliants	Coolants, Wetting agents (Not available in India), Defoliants
Trash (%)	25 (Combs); 17(Brush)	12-19
Pre-cleaner installed	Yes	No
Plant loss (%)	2	15
Field loss	5	12
Working speed kmph	2.66	4.5
Time taken hrs/ha	4.18	3.02

Diffusion of Cotton Harvester technology

- State Driven - Soviet Union (Diffusion slower and even reversed)

- Market Driven – USA (classic S-shaped diffusion pattern)

- India purely market driven. John Deere trying to introduce spindle type picker for several years without significant success.

Additional Cleaners for Machine Picked Cotton

Cylinder Cleaner

Stripper

Stick Machine

Impact Cleaner

Tower Drier

- Cylinder cleaner: opening the wads/locks of cotton
- Stripper: dislodging of large trashes
- Stick machine: removal of large vegetable trashes like burs, sticks etc.
- Impact cleaner: rotational grids remove fine trashes.
- Tower drier: maintains 6% moisture content for cleaning efficiency

Cost of facility US$ 155000

Setup for Pre-cleaning of Machine Picked Cotton at Bajaj Steel Industries, Nagpur

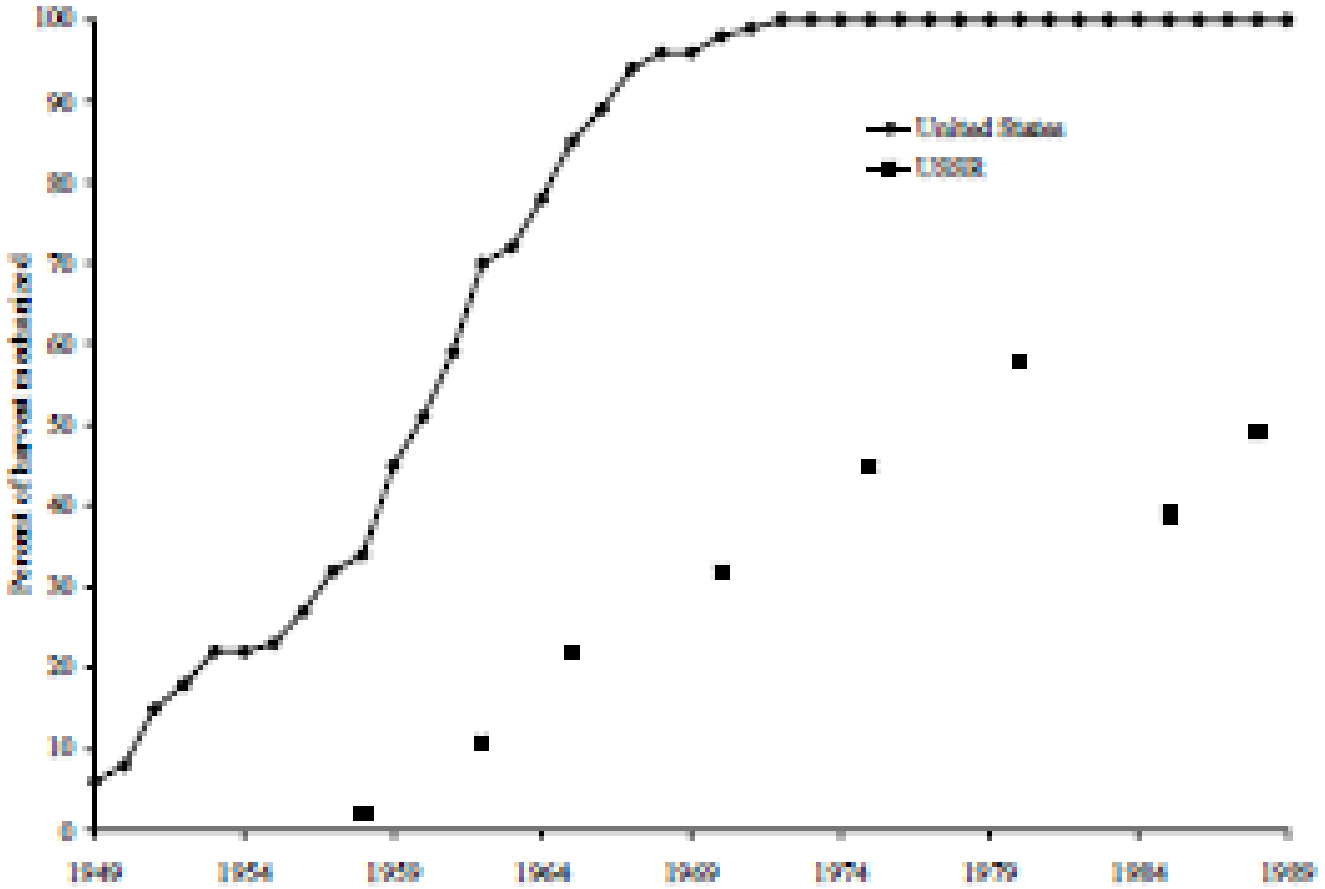


FIGURE 1
THE MECHANIZATION OF COTTON-HARVESTING IN THE UNITED STATES AND THE USSR, 1949–1988

Source: Richard Pomfret, State directed diffusion of technology: The mechanization of cotton harvesting in Soviet Central Asia

From archives – animal drawn pickers

Gus Horse Drawn Picker

John Deere Horse Drawn Picker

Automated Picking?

Benefits of small holder mechanization

- Saving in time
- Saving in labour
- Reduced drudgery
- Positive *social changes. E.g, release of family labor may result in longer and higher* school education
- Successful mechanization can increase rural income
- Machines may create interest in modem technology and stimulate practical training in operating, maintaining and repairing them

….**If appropriate machinery and technology chosen**