Sustainable Agricultural Mechanization

9th TC of CSAM

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Central Institute of Agricultural Engineering, Bhopal
Indian Council of Agricultural Research, New Delhi, India
Major Cropping Systems in India

- Rice – wheat (10.5 m ha)
- Rice – rice (5.89 m ha)
- Cotton – wheat (1.09 m ha)
- Soybean – wheat (2.23 m ha)
- Maize – wheat (1.86 m ha)
- P. millet - wheat (2.26 m ha)
Indian Agriculture

- Net sown area: 140 million ha (42.6%)
- Agricultural workers - 263 million
- Employs about 55% of the work force
- Provides livelihood to about 60% of the population
- Contributes 14% to the Gross Domestic Product (GDP)

- Yearly production
  - Food grains – 259 million tonne (2012-13)
  - Fruits – 76 million tonne (2011-12)
  - Vegetables - 156 million tonne (2011-12)

- No. of land holdings – 138 million
Indian Agriculture

- Small fragmented land holdings, hill agriculture and shifting cultivation
- 15% farms are semi-medium (2-4 ha), medium (4-10 ha) and large (more than 10 ha) sizes
- 85% are small and marginal (< 2 ha)

Approach to mechanization of Indian agriculture

- Improved equipment and
- Enhanced farm power supply

Maintain a socially desirable mix of human labour, draught animal power and mechanical power
Challenges

- India accounts for 2% of World’s geographical area and 4% of water resources
- But, it supports 17% of total human population and 15% of livestock
- Shrinkage of farm holding
- Scarcity of farm worker in peak seasons due to MGNREGA.
- The challenges in 21st century:
  - Food, nutritional and livelihood security
  - Reducing rural poverty through inclusive growth of farm mechanization
  - Reduce or reverse natural resource degradation, especially land

These challenges need to be resolved in the face of uncertainties of ‘Climate Change’.
# Population Dynamics of Indian Agricultural Workers (No. in million)

<table>
<thead>
<tr>
<th>Particulars</th>
<th>2001</th>
<th>2011</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country’s population</td>
<td>1029</td>
<td>1211</td>
<td>1323</td>
</tr>
<tr>
<td>No. of workers as % of population</td>
<td>39</td>
<td>39.8</td>
<td>42.8</td>
</tr>
<tr>
<td>Total no. of workers</td>
<td>402</td>
<td>482</td>
<td>566</td>
</tr>
<tr>
<td>% of agricultural workers to total workers</td>
<td>58.2</td>
<td>54.6</td>
<td>40.6</td>
</tr>
<tr>
<td>No. of agricultural workers</td>
<td>234</td>
<td>263</td>
<td>230</td>
</tr>
<tr>
<td>% of females in agril. work force</td>
<td>39</td>
<td>37.2</td>
<td>45.0</td>
</tr>
<tr>
<td>No. of male agricultural workers</td>
<td>143</td>
<td>165.7</td>
<td>126.5</td>
</tr>
<tr>
<td>No. of female agricultural workers</td>
<td>91</td>
<td>97.31</td>
<td>103.5</td>
</tr>
</tbody>
</table>
Cultivators reduced by 7%, Agril. labourers increased by 35%

Number of Agricultural workers

Male agril. labourers increased by 46%
Female agril. labourers increased by 27%
## Global Ranking of India in Farm Production and Productivity

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production Rank</th>
<th>Production in 2011 (million t)</th>
<th>Productivity Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy</td>
<td>2(^{nd})</td>
<td>157.90</td>
<td>30(^{th})</td>
</tr>
<tr>
<td>Wheat</td>
<td>2(^{nd})</td>
<td>86.87</td>
<td>22(^{nd})</td>
</tr>
<tr>
<td>Maize</td>
<td>6(^{th})</td>
<td>21.76</td>
<td>35(^{th})</td>
</tr>
<tr>
<td>Groundnut</td>
<td>2(^{nd})</td>
<td>6.96</td>
<td>40(^{th})</td>
</tr>
<tr>
<td>Rapeseeds</td>
<td>3(^{rd})</td>
<td>8.18</td>
<td>28(^{th})</td>
</tr>
<tr>
<td>Pulses</td>
<td>1(^{st})</td>
<td>0.70</td>
<td>44(^{th})</td>
</tr>
<tr>
<td>Soybean</td>
<td>5(^{th})</td>
<td>12.21</td>
<td>44(^{th})</td>
</tr>
<tr>
<td>Potato</td>
<td>2(^{nd})</td>
<td>42.34</td>
<td>26(^{th})</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>2(^{nd})</td>
<td>342.38</td>
<td>9(^{th})</td>
</tr>
<tr>
<td>Fruits</td>
<td>2(^{nd})</td>
<td>76.40</td>
<td>-</td>
</tr>
<tr>
<td>Vegetables</td>
<td>2(^{nd})</td>
<td>155.90</td>
<td>-</td>
</tr>
<tr>
<td>Continent</td>
<td>Paddy (kg/ha)</td>
<td>Wheat (kg/ha)</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>North America</td>
<td>7941.2</td>
<td>2988.6</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>4365.0</td>
<td>2040.1</td>
<td></td>
</tr>
<tr>
<td>Latin America</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>10000</td>
<td>6448.2</td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td>5143.4</td>
<td>6590.1</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>4365.0</td>
<td>2040.1</td>
<td></td>
</tr>
<tr>
<td>Egypt</td>
<td>2976.7</td>
<td>2840.8</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>2318.1</td>
<td>6590.1</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>1603.3</td>
<td>4748</td>
<td></td>
</tr>
</tbody>
</table>

India very low on productivity.

Yield of principal crops in developed nations is much higher than other developing nations, one of the reason being less adoption of automation.

* Figures represents Yield of major crops during 2009
** Yield is defined as kg/ha
Source: FAOSTAT
Mechanization - Precursor of Development

The green, red, and blue components of the colours of the countries represent the percentages for the agriculture, industry, and services sectors, respectively.
Indian Agriculture

- **Highest arable land** - 47% of total land against Avg. 11% in the world
- **Round the year cultivation** - 20 Agro-climatic regions and 46 soil types suited for round the year cultivation
- **Ranks first** in production of Pulses, Sorghum, Jute and allied fibers
- **Second largest producer** of Wheat, Rice, Groundnut, Tea, Fruits and Vegetables, Sugarcane
- **Third largest producer** of Mustard, Potatoes, Cotton lint, etc.
- **137.8 million cultivators**, over 5.0% own > 4 ha. Avg farm land size <2 ha,

**Average land holding and no. of farmers**

- LARGE > 10 ha (1.0 mil)
- Medium 4-10 ha (5.9 mil)
- Semi medium 2-4 ha (13.8 mil)
- Small 1-2 ha (24.7 mil)
- Marginal < 1 ha (92.4 mil)

Bottom of Pyramid Country; Affordability, Equipment size are key to success. Emerging - Cooperative ownership model/custom hiring, use of high end equipment
## Cropping Intensity, Power Availability on Indian Farms

<table>
<thead>
<tr>
<th>Year</th>
<th>Cropping intensity (%)</th>
<th>Productivity (t/ha)</th>
<th>Power available (kW/ha)</th>
<th>Power per unit production (kW/t)</th>
<th>Net sown area per tractor (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975-76</td>
<td>120</td>
<td>0.94</td>
<td>0.48</td>
<td>0.51</td>
<td>487</td>
</tr>
<tr>
<td>1985-86</td>
<td>127</td>
<td>1.18</td>
<td>0.73</td>
<td>0.62</td>
<td>174</td>
</tr>
<tr>
<td>1995-96</td>
<td>131</td>
<td>1.50</td>
<td>1.05</td>
<td>0.70</td>
<td>84</td>
</tr>
<tr>
<td>2005-06</td>
<td>135</td>
<td>1.65</td>
<td>1.47</td>
<td>0.89</td>
<td>47</td>
</tr>
<tr>
<td>2010-11</td>
<td>137</td>
<td>1.92</td>
<td>1.68</td>
<td>0.88</td>
<td>31</td>
</tr>
</tbody>
</table>
Agricultural productivity has a positive correlation with farm power availability
Population Engaged in Agriculture Vis-a-vis Level of Farm Mechanization

Higher share of labour (55%) with lesser contribution to farm mechanisation (40%) in India makes farming less remunerative and leads to farmers’ poverty.
Power Availability Trend….

The changing face of technology is leading to increase in mechanisation and this trend is expected to continue in near future.

Share of agricultural worker & draught animals came down from 60.5% in 1971-72 to 13.2% in 2010-11.
Power-wise Trend in Sale of Tractors in India

Huge opportunity at entry level, virgin sub 15 hp segment replacing bullock

Sales to witness polarization towards high- and low-power segments
## Level of Farm Mechanization in India

<table>
<thead>
<tr>
<th>Operations</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil working and seed bed preparations</td>
<td>42</td>
</tr>
<tr>
<td>Seeding and planting</td>
<td>29</td>
</tr>
<tr>
<td>Plant protection</td>
<td>34</td>
</tr>
<tr>
<td>Irrigation</td>
<td>37</td>
</tr>
<tr>
<td>Harvesting and threshing</td>
<td>60-70% for wheat and rice and &lt; 5% other crops</td>
</tr>
</tbody>
</table>

Overall about 40-45 %
Sustainable agriculture

Intensity of soil disturbance

Crop rotation

Surface crop retention

Conventional agriculture

Minimum Tillage

Direct seeding

Conservation agriculture
Conservation Agriculture

- Minimum or no soil disturbance (Zero tillage, No-tillage)
- Permanent soil cover (residues or green manure cover crops (GMCCs))
- Crop rotation
- Integrated disease and pest management
- No burning
Tractor drawn laser land leveller

Used for micro levelling of field and pulling loose soil from one place to other
### Performance evaluation of laser guided land leveler

<table>
<thead>
<tr>
<th>S. No</th>
<th>Variables</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Forward speed, km/h</td>
<td>4.0-6.0</td>
</tr>
<tr>
<td>2.</td>
<td>Field capacity, ha/h</td>
<td>0.10-0.20</td>
</tr>
<tr>
<td>3.</td>
<td>Standard deviation of reduced level after leveling, cm</td>
<td>0.55-0.90</td>
</tr>
<tr>
<td>4.</td>
<td>Leveling index, cm</td>
<td>0.44-0.63</td>
</tr>
<tr>
<td>5.</td>
<td>Volume of soil tilled, m³</td>
<td>50-90</td>
</tr>
<tr>
<td>6.</td>
<td>Cost of leveling, Rs./ha</td>
<td>1670-3000</td>
</tr>
</tbody>
</table>
Animal drawn manure spreader

- Developed at SHIATS, Allahabad and CIAE Bhopal
- Hopper capacity: 3.75-4.00 q
- Width of operation: 1.1 to 1.2 m
- Application rate: 4-18 t/ha
- Field capacity: 0.18-0.20 ha/h

Tractor operated farm yard manure spreader

Capacity: 2 tonne
Field capacity: 0.38 ha/h at 2.5 km/h
Type of spreading unit: A cylinder of 40 mm diameter having 12 numbers of beaters on periphery.
Tractor-operated Rotavator

- Prepares dry seed bed in one operation and in heavy soils in two operations. It mixes crop residue and weeds in soil effectively.
- Field capacity: 0.25–0.40 ha/h
- The machine saves about 40-60% of time and 25-40% of fuel consumption as compared to the conventional tillage implements.
- Field condition after rotavator operation
Plastic Mulch Laying Machine

It has great potential for adoption in vegetable cultivation

Field capacity: 0.23 ha/h
Efficiency of plastic laying machine: 75%
Inverted ‘T’ furrow opener for Zero till-drip

Energy & moisture conservation
- Saving in time: 40-70%
- Saving in fuel: 64%
- Saving in water: 10-15%

Zero till-drip in operation
(5 million ha area)
### CAM Developed in India

**Machine parameters**

<table>
<thead>
<tr>
<th></th>
<th>Zero till drill</th>
<th>Strip till drill</th>
<th>Roto till drill</th>
<th>Slit till drill</th>
<th>Conventional (3 Tillage + Sowing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working width, mm</td>
<td>1600-2000</td>
<td>1800</td>
<td>2000</td>
<td>1800</td>
<td>1850</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>210</td>
<td>350</td>
<td>350</td>
<td>300</td>
<td>-</td>
</tr>
<tr>
<td>Unit price, Rs.</td>
<td>30000</td>
<td>60000</td>
<td>70000</td>
<td>55000</td>
<td>20000 + 25000</td>
</tr>
<tr>
<td>Time, h/ha</td>
<td>3.23 (70.1)</td>
<td>4.17 (61.2)</td>
<td>3.45 (68.1)</td>
<td>2.50 (76.8)</td>
<td>10.80</td>
</tr>
<tr>
<td>Fuel used, l/ha</td>
<td>11.50 (66.8)</td>
<td>17.50 (49.4)</td>
<td>14.80 (57.2)</td>
<td>10.00 (71.1)</td>
<td>34.60</td>
</tr>
<tr>
<td>Operational energy, MJ/ha</td>
<td>650 (67.2)</td>
<td>1002 (49.3)</td>
<td>784 (60.3)</td>
<td>565 (71.4)</td>
<td>1976</td>
</tr>
</tbody>
</table>
**CAM: Economic impact**

<table>
<thead>
<tr>
<th>Particular (s)</th>
<th>Zero till seeding</th>
<th>Strip till seeding</th>
<th>Roto till seeding</th>
<th>Slit till seeding</th>
<th>Conventional (3 Tillage + Sowing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of operation, Rs./ha</td>
<td>1400 (58.8)</td>
<td>2000 (41.2)</td>
<td>1800 (47.1)</td>
<td>1000 (70.6)</td>
<td>3400</td>
</tr>
<tr>
<td>Saving, Rs./ha</td>
<td>2000</td>
<td>1400</td>
<td>1600</td>
<td>2400</td>
<td>-</td>
</tr>
<tr>
<td>Command area, ha</td>
<td>45</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td>Benefits, Rs./year</td>
<td>90000</td>
<td>42000</td>
<td>64000</td>
<td>120000</td>
<td>-</td>
</tr>
<tr>
<td>No. of units</td>
<td>25000</td>
<td>500</td>
<td>2000</td>
<td>05</td>
<td>-</td>
</tr>
<tr>
<td>Annual benefits, Rs., million</td>
<td>2250</td>
<td>21</td>
<td>128</td>
<td>0.6</td>
<td>-</td>
</tr>
</tbody>
</table>
Tractor operated Raised bed planter
inclined plate type

Suitable for sowing of wheat, winter maize and other crops on ridges.

Field capacity - 0.2 ha/h
Saves - 20-30% water through furrow irrigation
Tractor operated Raised bed planter
inclined plate type

Crops sown on raised bed

Wheat

Groundnut

Lady's finger
## Bed planting on fresh and permanent beds

<table>
<thead>
<tr>
<th>Particular</th>
<th>Planting on fresh beds with tillage</th>
<th>Planting on permanent beds</th>
<th>Flat sowing zero tillage</th>
<th>Conv. Flat sowing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time required, h/ha</td>
<td>13.0</td>
<td>5.0</td>
<td>3.2</td>
<td>10.8</td>
</tr>
<tr>
<td>Operational energy, MJ/ha</td>
<td>2605</td>
<td>1154</td>
<td>650</td>
<td>1976</td>
</tr>
<tr>
<td>Cost of operation, Rs./ha</td>
<td>4300</td>
<td>1750</td>
<td>1400</td>
<td>3400</td>
</tr>
<tr>
<td>Savings over conv. practice, Rs./ha</td>
<td>-</td>
<td>1650</td>
<td>2000</td>
<td>-</td>
</tr>
<tr>
<td>Command area, ha</td>
<td>-</td>
<td>30</td>
<td>45</td>
<td>-</td>
</tr>
<tr>
<td>Annual benefit, Rs./ha</td>
<td>-</td>
<td>49500</td>
<td>90000</td>
<td>-</td>
</tr>
<tr>
<td>No. of units</td>
<td>-</td>
<td>500</td>
<td>25000</td>
<td>-</td>
</tr>
<tr>
<td>Annual benefits, Rs., million</td>
<td>-</td>
<td>25</td>
<td>225</td>
<td>-</td>
</tr>
</tbody>
</table>
Pre-emergence herbicide strip applicator
The worker has to insert her fingers in mud about 0.17 million times per ha. It causes skin problem to fingers/hand.

- Involves a lot of drudgery due to operation in bending posture.

- Output: 40 m²/h

Field capacity: 135 m²/h
Cost: Rs. 10000/-
Power source: 1 person
Operating speed: 0.5 km/h

Bending is avoided
Lowland Paddy Seeder

Results in saving of seed, labour and water

- Field capacity: 0.06 - 0.12 ha/h
- Cost of the unit: Rs. 4000 - 5700/
- Cost of operation: Rs. 450 per ha
- Seed rate: 50 kg/ha
- Row spacing: 200 mm (8 row)
Tractor Mounted Rice Seeder (TNAU)

- Field capacity: 0.65 ha/h
- Cost of the unit: Rs. 30,000/- (attachment)
- Cost of operation: Rs. 400/ha
- Saving in labour and time: 72%
SRI Planting Manual Method
SRI Self-propelled Transplanter (TNAU)
Self-propelled reaper binder

Cuts the crop and makes the bundle of about 5 kg and drops in the field.

- Field capacity = 1.5-2.0 ha/day
- Grain losses = 2-5% for wheat
  1-5% for paddy
High capacity multi-crop thresher

- Used for threshing of cereals, pulses & oil seeds crops.

- The grain output capacity
  - Wheat - 16-20 q/h
  - Raya - 8-10 q/h
  - Gram - 6-8 q/h
  - Green gram - 4-5 q/h

- Threshing efficiency - 98-99%,
Self-propelled Rice Combine (CLASS)

Field capacity: 4 ha/day
Cost: Rs. 16.00 lakh

Tractor Mounted Combines

Field capacity: 4 ha/day
Cost: Rs. 12.50-14.00 lakh
Tractor operated straw reaper (combine)
Tractor operated straw reaper with trailer

Field capacity: 0.4 ha/h
Cost: Rs. 3.25 lakh
Hay rake in operation to collect paddy straw

Straw baler being used to make bales of paddy straw
Bio-fuels and renewable energy

- Contribution of the Renewable energy to Farm power availability is 1443 MW i.e. 0.7%
- Renewable Energy technologies like solar, biomass, hydro, etc are deployed both in rural and urban areas to curb the growing gap between the demand and supply of power.
- A target to harness 20000 MW of solar energy by 2022 has been set up under Prime Minister Solar Energy Mission
- Indian clean development mechanism projects cover a range of sectors viz power generation from renewable energy, particularly wind and hydro power, biomass applications, waste heat and energy recycling.
Large Capacity  Fixed Dome Type Biogas Plants

Capacity:
10 to 110 m³ gas/day

Digester & gas dome - made of brick masonry

Water requirement - reduced by up to 70%

Cost of plant - 50% less than KVIC

Plants set-up in Punjab, Raj., MP, MS, Karnataka & Goa

110 m³ fixed dome biogas plant at a farmer’s site at village Malsian (Distt. Jalandhar)
Walk-in-type Solar Tunnel Dryer for Agro-industrial Applications

Surgical cotton drying at M/s Raj Surgical, Udaipur

Three units each of 3.75 m x 19 m (1800 kg cotton/batch) MC 40% → 5% (one day), Investment: Rs. 3.30 lakh
Economic benefit – Rs. 172250/unit/year over conventional system

These dryers are also used for drying of coconut splits, gooseberry, grapes, chillies, stevia leaves etc.
Forced Circulation Solar Dryer

Forced circulation solar dryer equipped with composite SAHs installed in a Gujarat State Forest Development Corporation’s Unit at Vadodara Unglazed flat plate type – Rs. 3,000/m² area

Packed bed type SAH panels installed on the roof of M/s Raghav Wollen Mills, Ludhiana

Cost of packed bed type – Rs. 4,500/m² area

Efficiency of the packed bed type SAH is 40% more as compared to sun drying
Solar Refrigerator for Rural Applications

Solar Refrigerator installed in a veterinary clinic near Anand

Solar Refrigerator installed at Veterinary laboratory of CSKHPKVV Palampur

SPRERI SPV refrigerator 80 l capacity, top opening 200 Wp panel, 24 V, 130 Ah, Cost: Rs. 1,20,000/- 20 units are in use in Veterinary Centres

Manufacturer: M/s Mamta Industries, Ahmedabad
Electricity from Solar Energy for Rural Applications

- **Street lighting**
  - PV module - 74 $W_p$
  - CFL - 11 W
  - Lead acid battery - 12 V, 75 AH

- **Irrigation water pumping**
  - PV module – 200-3000 $W_p$
  - Pump of matching capacity
  - Cost: Rs. 150000/- (900 $W_p$)

Cost of SPV panel – Rs. 125 –150/W, Cost of electricity – Rs. 15-20/kWh
Bio-diesel Plant (TNAU design)

Bio-diesel plant - 250 l/day, Yield - 75-90%
Biomass gasifier based power generation system
Network project of the ICAR launched in February, 2011 with CRIDA, Hyderabad as the lead centre.

The project aims to enhance resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstration.

Central Institute of Agricultural Engineering (CIAE), Bhopal is one of the core institute giving major thrust on Engineering interventions for conservation agriculture, precision farming and energy use efficiency.
Testing Network in India

1. CFMT&TI, Budni, M.P.
2. NRFMT&TI, Hisar, Haryana
3. SRFMT&TI, Garladinne, A.P.
4. NERFMT&TI, Biswanath Chariali, Assam

Other Institutions for Testing Agricultural Machinery in India (28)

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAUs</td>
<td>21</td>
</tr>
<tr>
<td>ICAR Institutes</td>
<td>2</td>
</tr>
<tr>
<td>IIT</td>
<td>1</td>
</tr>
<tr>
<td>State Govt. Institute</td>
<td>4</td>
</tr>
</tbody>
</table>
Policy Mandate

 Requirement for Farm Mechanization
  - Farm power requirement by 2020 - 2.5 kW/ha
  - Removal of regional disparities

 Infrastructural and Institutional Framework
  - Adequate engineering infrastructure at implementation level
  - Effective training and extension service
  - Repair and maintenance facilities
  - Machinery banks for custom hiring services
  - Credit at simple terms

 Appropriate Farm Machines and Equipment
  - For small and marginal land holdings
  - Crop specific quality machines
  - For hill agriculture
  - Gender specific
Policy Initiatives by the Government of India to Promote Farm Mechanization

- **Training**
  - Establishment of four Farm Machinery Training and Testing Institutes (FMTTI)

- **Demonstration**
  - Large scale demonstration of equipment at farmers field

- **Incentives for Purchase of Equipment**
  - Subsidy through MMA, NFSM, NHM and similar other schemes available to all categories of farmers
  - Incentives for establishment of Machinery Banks at block levels for custom hiring services

- **Identification of Machines**
  - Hill agriculture
  - Gender friendly tools and equipment
  - Crop specific package of machines
Policy Initiatives by the Government of India to Promote Farm Mechanization

**Manufacturing Sector**
- De-reservation of manufacturing of agricultural machines from small scale sector
- Training on manufacturing technologies

**Quality of Machines**
- Minimum performance standards for tractors, power tillers and combine harvesters framed
- Standard specifications for all machines
- Equipment promotion through subsidy: Testing by FMTTI or BIS certification is mandatory

**Credit**
- NABARD refinance available and financing norms simplified

**Agro Processing Sector**
- Scheme on post harvest technology
- Technologies developed by ICAR/CSIR promoted
Increasing the reach of farm mechanization to small and marginal farmers and to the regions where availability of farm power is low

Offsetting adverse ‘economies of scale’ and ‘higher cost of ownership’ of high value farm equipment by promoting ‘Custom Hiring Centre’ for agricultural machinery

Passing the benefit of hi-tech, high value and hi-productive agricultural machinery to farmers through creating hubs for such farm equipment.

Promoting farm mechanization by creating awareness among stakeholders through demonstration and capacity building activities

Ensuring quality control of newly developed agricultural machinery and equipment through performance evaluation and certifying them at designated testing centers located all over the country.
<table>
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<tr>
<th>S. No.</th>
<th>Components</th>
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<tbody>
<tr>
<td>1</td>
<td>Promotion &amp; strengthening of agricultural mechanisation through training, testing and demonstration</td>
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<tr>
<td>2</td>
<td>Post harvest technology and management</td>
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<tr>
<td>3</td>
<td>Financial assistance or procurement subsidy for selected agriculture machinery and equipment</td>
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<tr>
<td>4</td>
<td>Establishment of farm machinery banks for custom hiring by small and marginal farmers</td>
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<tr>
<td>5</td>
<td>Establishing hi-tech and high productive equipment hub for custom hiring</td>
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<tr>
<td>6</td>
<td>Enhancing farm productivity at village level by introducing appropriate farm mechanization in selected villages</td>
</tr>
<tr>
<td>7</td>
<td>Creating ownership of appropriate farm equipment among small and marginal farmers in the eastern/north eastern regions</td>
</tr>
</tbody>
</table>
Individual Ownership OR Custom Hiring

Key Question is How to cater marginal and small farmers who aggregate to > 80% of cultivators

Fragmented Land Holdings (<2 ha): Adverse Economies of Scale

Subsidy and Bank Linkages: Poor credit worthiness of farmers

High cost of ownerships: Many can not afford

Custom Hiring
Conclusions

- Future farm mechanization through mechanical sources of power
- R&D in farm mechanization through Public Private Partnership mode
- Equipment/technology for increasing input use efficiency
- Machines suitable for custom hiring – high capacity, high labour productivity
- Quality manufacturing and after sales support for reliability of farm machinery.
Conclusions

- Mechanization of horticulture and hill agriculture
- Mechanization of sugarcane harvesting and cotton picking
- Centralized nursery raising for horticultural crops and rice
- Covered cultivation
- Adoption of conservation agriculture and precision farming
- Consideration of ergonomics and safety in farm equipment/machinery design
- Contract farming
- Farm machinery bank
Thank You

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