Agricultural Mechanization Strategies in India

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Average Annual Rainfall Map of 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
<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>
### 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&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>157.90</td>
<td>30&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Wheat</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>86.87</td>
<td>22&lt;sup&gt;nd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Maize</td>
<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>21.76</td>
<td>35&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Groundnut</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>6.96</td>
<td>40&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Rapeseeds</td>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>8.18</td>
<td>28&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pulses</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>0.70</td>
<td>44&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Soybean</td>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>12.21</td>
<td>44&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Potato</td>
<td>2&lt;sup&gt;th&lt;/sup&gt;</td>
<td>42.34</td>
<td>26&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>342.38</td>
<td>9&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fruits</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>76.40</td>
<td>-</td>
</tr>
<tr>
<td>Vegetables</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>155.90</td>
<td>-</td>
</tr>
</tbody>
</table>
Crop Scenario

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
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
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
AGRICULTURE SCENARIO IN INDIA

- Poor utilisation efficiency of critical inputs like water, seeds, fertilizers, chemicals and energy
- Benefits of engineering R&D not reaching the farmers expeditiously
- Very high post harvest losses in grains and perishables
- Only 10% of produce is processed in the country as against 40-60% in other South Asian countries
- Very low value-addition in production catchments
- Nutritional insecurity of rural population.
Declining profitability in agriculture is due to:

- High cost of production and low levels of productivity
- Subsistence farming rather than professional enterprise
- Low returns to farmers
- Low levels of by-product utilisation
SWOT

Strengths

- Large infrastructure of over 20,000 manufacturers in small scale industry
- Vast network of academic and R&D institutions including AICRPs under NARS for human resource development, R&D and extension
- Trained manpower for R&D in agricultural engineering
- Over 100 cooperating centers of AICRPs is the area of agricultural engineering
- Computer Aided Design adopted by the institutes for high pace of R&D.
Weaknesses

- Unreliable after sales service of agricultural equipment
- Poor TOT for agricultural engineering technologies through state departments
- Poor liaison with industries for R&D and commercialization
- Non effective feedback system
- Absence of non-land economic activities
- Non systematic marketing of agricultural equipment.
Opportunities

- Entrepreneurship development for custom hiring of farm machinery and agro-processing equipment
- Post harvest loss reduction and value addition at the production catchments through rural level agro-processing centers
- Establishment of value chain for commercial supply, transport and marketing of agricultural produce
- Opportunity to increase in irrigated area by introducing micro-irrigation
- Reducing yield gaps and increasing productivity through precision farming technologies.
Threats

- Low profitability in agricultural enterprises due to subsistence farming
- Migration of farmers from agriculture
- Fragmentation and continuous reduction of operational holdings
- Slow pace of R&D and commercialization
- Inadequate infrastructure back up for after sales support for farming equipment
- Renewable energy technology still subsidy dependent.
Strategies for Mechanization of Indian Agriculture
Strategies

- Design, development and commercialisation of farm implements and machinery for mechanisation of -
  - conservation agriculture
  - high capacity energy efficient machines for custom hiring
  - spraying of tall tree
  - cotton picking
  - sugarcane harvesting
  - horticultural crops
  - hill area agriculture
  - nursery raising under covered cultivation
Design, development and commercialisation of farm implements and machinery for mechanisation of:

- root crops harvesting
- feed and fodder production
- seed spices crops
- dryland agriculture
- oilseeds and pulses

Development of machinery for adoption of precision farming for improved input use efficiency of seed, fertiliser and chemical.
Strategies

- Development/adoptions of manually guided power operated equipment for hilly terrains
- Farm machinery management for efficient and optimum utilisation of available agricultural machinery
- Streamlining of testing procedure, training of engineers and conducting testing of farm equipment for standardisation and quality control in farm equipment manufacturing
- Development of package of farm equipment for major cropping systems for different states
- Multiplication of R&D products at Prototype Manufacturing Workshops (PMWs) for multi-location trials.
Establishment of Farm Machinery Bank for machines being manufactured elsewhere in the country and supply to users/farmers

Conducting prototype feasibility testing and front line demonstration of improved farm implements and machinery in different regions to bridge mechanisation gap and to obtain feedback for design refinements.

Promoting custom hiring services through entrepreneurship for use of high capacity farm equipment to ensure timeliness of operation and reduction in cost of operation.
Increase in average supply of power to agriculture from about 1.7 kW/ha in 2010 to 2.5 kW/ha by 2025.

Consolidation of widely fragmented and scattered land holdings in many parts of the country.

Mechanization for all categories of farmers and to all regions of the country especially the rainfed areas.

Increase interaction among farmers, R&D workers, departments of agriculture and industry to have access to the latest equipment and technology.
National Mission on Farm Mechanization

- 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.
### S. No. | Components
---|---
1 | Promotion & strengthening of agricultural mechanisation through training, testing and demonstration
2 | Post harvest technology and management
3 | Financial assistance or procurement subsidy for selected agriculture machinery and equipment
4 | Establishment of farm machinery banks for custom hiring by small and marginal farmers
5 | Establishing hi-tech and high productive equipment hub for custom hiring
6 | Enhancing farm productivity at village level by introducing appropriate farm mechanization in selected villages
7 | Creating ownership of appropriate farm equipment among small and marginal farmers in the eastern/north eastern regions
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 and 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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