India, Conservation Agriculture and Agricultural Mechanization Strategies

Cross fertilization of ideas

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Cereal Systems Initiative for South Asia (CSISA) Project

Punjab Hub

CSISA Punjab Hub – activities, adoption outcomes, needs & future plans

Cross fertilization of ideas as an informal partner

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Productivity and Mechanization in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Cropping intensity (%)</th>
<th>Food grain 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>0.944</td>
<td>0.51</td>
<td>487</td>
<td></td>
</tr>
<tr>
<td>1985-86</td>
<td>127</td>
<td>1.175</td>
<td>0.62</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>1995-96</td>
<td>130</td>
<td>1.491</td>
<td>0.70</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>2004-05</td>
<td>135.7</td>
<td>1.652</td>
<td>0.89</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>2005-06</td>
<td>136.4</td>
<td>1.715</td>
<td>0.88</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>2006-07</td>
<td>138.1</td>
<td>1.756</td>
<td>0.9</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>2007-08</td>
<td>139</td>
<td>1.86</td>
<td>0.87</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>2008-09</td>
<td>139.02*</td>
<td>1.909</td>
<td>0.87</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>2009-10</td>
<td>139.22*</td>
<td>1.798</td>
<td>0.96</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

Cropping intensity and power availability on Indian farms

Agril. Mechanization in India

• **Demand** – Yes, farmer participatory, multi crop and multi task, options, owning v/s hiring,

• **Supply issues** – very good manufacturing, cost of production, common facility (tool Rooms etc) & cluster formation

• **Policy & institutional Issues** – Govt Support, subsidy with quality rider, promotion, Taxes, testing centers, Farm machinery service centre, new technology through co op societies

• **Constraints** – Land Holding, Economic Condition, seasonal use, size & shape of Fields, terrain, mind set and machine v/s Labour

• **Best Practices** – AMS for Sustainable Agriculture

• **Way Forward** – Develop & promote CA Equipment & Strategies accordingly but with clear cut messages no policy mismatch
Highly Mechanized Indian State – Punjab Case

- 1.2 % area
- 95 % irrigated area
- 11 % tractors
- 190 % cropping intensity
- 50% rice and 50 % wheat in the central pool

At What Cost?

Tractor Population = 4.2 Lacs

Conservation Agriculture

Three Principles
- No/Minimum Tillage
- Soil Cover with residue
- Crop Rotation

Three Benefits
- Enhanced Productivity
- Richer Resources
- Climate Adaptation

AMS v/s Issues

- Degradation of Natural Resources (Soil, Water & Environment)
- Stagnation in the crop Yield
- Declining Farmers Income
- Scarcity of Farm Labor
- Mechanization for small Farmers
- Climate change
- Sustainability of Agriculture

Choosing Directions

- Un-sustainability can not be the option
- Systems need to be both biophysically and socio-economically sustainable.
- Sustainability also demands confronting climate change

Water

Efficient utilization of available water sources

Enhance water productivity at field level

Best option to redress the water scarcity

What is laser leveling?

- Laser land leveling is leveling the field within a certain degree of desired slope using a guided laser beam through out the field.
Bihar (N = 60)

**Saving in Irrigation Costs under Laser Leveling over Traditional Leveling**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Laser</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice (11)</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Wheat (38)</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Maize (09)</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Potato (02)</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Jat et al, 2009b

**Land Leveling effects on RW system productivity**

![Graph showing land leveling effects on RW system productivity]

- **Laser**: 0.53, 0.76
- **Traditional**: 0.76, 0.53

**Water saving over time, effect of tillage (on-station)**

![Graph showing water saving over time]

- **Conventional**: 25.0, 20.0, 15.0, 10.0
- **Double no-till**: 20.0, 15.0, 10.0, 5.0

With Due Acknowledgement to Dr. Raj Gupta & CIMMYT
Direct Seeded Rice
Some More Efforts
Residue Management

POSSIBLE STRAW MANAGEMENT PRACTICES

- Collection
- Straw incorporation (most difficult)
- Burning
  - Complete burning (mostly practiced)
  - Partial burning
- Straw Mulch

Mostly Practiced Rice Residue Management Technique
Weed matter growth in mulched and un-mulched plots

Weed matter after 45 days of sowing

Weed matter after 90 days of sowing

Value of Nutrient Lost in Burning Rice Straw per ha

Canopy temperature under various tillage option

Wheat Phenology 2007-08

Source: Dr. Yadwinder Singh

Rice Residue Management
## Performance of wheat during last three conjunctive years

<table>
<thead>
<tr>
<th>Districts</th>
<th>Year (locations)</th>
<th>Yield (t/ha)</th>
<th>% increase*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CT</td>
<td>HS</td>
</tr>
<tr>
<td>4</td>
<td>2007-08 (46)</td>
<td>4.59</td>
<td>4.73</td>
</tr>
<tr>
<td>2</td>
<td>2008-09 (14)</td>
<td>4.34</td>
<td>4.54</td>
</tr>
<tr>
<td>12</td>
<td>2009-10 (94)</td>
<td>4.35</td>
<td>4.48</td>
</tr>
<tr>
<td>Mean</td>
<td>(154)</td>
<td>4.46</td>
<td>4.58</td>
</tr>
</tbody>
</table>

*Over conventional

[Image of wheat field]

[Image of germination]

[Image of Rs 60000-65000/ha]

[Image of field with machinery]
Moong Yield was 1.6 t/ha

Yield (kg/ha) gap of wheat in cotton grown and rice grown areas

New CA Seeder Prototype

Newly Developed Prototype

Sowing wheat on date 11-11-09
Yield Comparison of Relay Seeding of wheat in standing cotton

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Village</th>
<th>Lat., Long.</th>
<th>Variety</th>
<th>DOS</th>
<th>DOS (FP)</th>
<th>Saving of Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gehri Butter</td>
<td>30.11608 N 074.88899 E</td>
<td>DBW 17</td>
<td>16-11-2010</td>
<td>21-12-2010</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>Jodhpur Romana</td>
<td>30.15721 N 074.90402 E</td>
<td>DBW 17</td>
<td>11-11-2010</td>
<td>19-12-2010</td>
<td>38</td>
</tr>
<tr>
<td>3</td>
<td>Jodhpur Romana</td>
<td>30.13931 N 074.90864 E</td>
<td>DBW 17</td>
<td>12-11-2010</td>
<td>19-12-2010</td>
<td>37</td>
</tr>
<tr>
<td>4</td>
<td>Gehri Butter</td>
<td>30.09837 N 074.70417 E</td>
<td>DBW 17</td>
<td>19-11-2010</td>
<td>19-12-2010</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>Jodhpur Romana</td>
<td>30.14429 N 074.91603 E</td>
<td>DBW 17</td>
<td>14-11-2010</td>
<td>07-12-2010</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>Gehri Butter</td>
<td>30.11971 N 074.90669 E</td>
<td>DBW 17</td>
<td>19-11-2010</td>
<td>18-12-2010</td>
<td>29</td>
</tr>
<tr>
<td>7</td>
<td>Jodhpur Romana</td>
<td>30.15997 N 074.90412 E</td>
<td>DBW 17</td>
<td>17-11-2010</td>
<td>17-12-2010</td>
<td>23</td>
</tr>
<tr>
<td>8</td>
<td>Gehri Butter</td>
<td>30.10112 N 074.90618 E</td>
<td>DBW 17</td>
<td>18-11-2010</td>
<td>07-12-2010</td>
<td>23</td>
</tr>
<tr>
<td>9</td>
<td>Jodhpur Romana</td>
<td>30.14533 N 074.90164 E</td>
<td>DBW 17</td>
<td>19-11-2010</td>
<td>02-12-2010</td>
<td>13</td>
</tr>
<tr>
<td>10</td>
<td>Bathinda</td>
<td>30.15911 N 074.90247 E</td>
<td>DBW 17</td>
<td>26-11-2010</td>
<td>16-12-2010</td>
<td>29</td>
</tr>
</tbody>
</table>

Within a column, means followed by the same letter are not significantly different at the 0.05 level of probability by the Duncan’s multiple range test (DMRT).

### Some Specifications

<table>
<thead>
<tr>
<th></th>
<th>Normal Tractor</th>
<th>High Clearance Tractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Clearance (cm)</td>
<td>45 cm</td>
<td>110 cm</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>2000 Kg</td>
<td>2350 Kg</td>
</tr>
<tr>
<td>Turning Radius</td>
<td>270</td>
<td>302</td>
</tr>
<tr>
<td>Seeding Speed</td>
<td>3.5 km/hr</td>
<td>17% less</td>
</tr>
<tr>
<td>Track Width</td>
<td>135 cm</td>
<td>202 cm</td>
</tr>
</tbody>
</table>

### Opportunities

- Very good Liaison with manufacturer
- Global market for need/farm size based machinery
- Custom hiring single window service is emerging for small & Marginal farmers
- Govt. should come forward to provide subsidies (with qualifier) on all CA /new machinery

### Future Needs & What Next

- Can we run Happy seeder in wet rice straw
- Can we apply Nitrogen mechanically in straw mulch
- Multi-crop ZT Planter for 2WT
- Laser Land Leveler for 2WT
- Capacity building of scientists Manufactures, Farmers

- Global challenges of mechanization for S/M size
- How Indian machinery manufacturing skills/strengths
- Cluster formation / better quality & Cost
- Multi-crop ZT Planter for 2WT
- Laser Land Leveler for 2WT
- Capacity building of scientists Manufactures, Farmers

Can we run Happy seeder in wet rice straw
- Can we apply Nitrogen mechanically in straw mulch
- Multi-crop ZT Planter for 2WT
- Laser Land Leveler for 2WT
- Capacity building of scientists Manufactures, Farmers
“Lot of changes are necessary to adopt conservation agriculture but the biggest change is in the mind.”

Franke Dijkstra
Pioneer Brazilian zero tillage farmer. Started 35 years ago.
Conservation Agriculture

Agriculture of the Future

Future of the Agriculture

Thanks