COUNTRY PAPER
ON
Conservation Agriculture: A Climate-Smart Agricultural Technology for Sustainable Crop Production in Bangladesh

23-25 November 2016, Hanoi, Vietnam

Presentation by

DR. SULTAN AHMMED
Member Director (NRM)
Bangladesh Agricultural Research Council, Dhaka, BANGLADESH
Conservation agriculture (CA) aims to conserve, improve and

- make more efficient use of natural resources through
- integrated management of available soil, water and biological resources combined with external inputs.

- It contributes to environmental conservation as well as to enhanced and sustained agricultural production.

- (i) less soil disturbance, (ii) allow crop residue management and (iii) keep beneficial crop rotation.
Climate Change Impact

- Summer are becoming hotter (*High temperature*)
- Monsoon irregular with untimely rainfall
- Increased river flow and inundation during monsoon
- Heavy rainfall over short period causing *water logging*
- Increased frequency, intensity and recurrence of flood
Crop damage due to flash flood
Very little rainfall in dry period
Crop failure due to drought
River bank erosion
Prolonged cold spell
Salinity intrusion along the coast region
DROUGHT

- North-western and northern regions of Bangladesh
- Area of 5.46 million Hectare.
- North-western Barind tract -drought prone.

Drought-prone area in Bangladesh
Climate vulnerable Areas in Bangladesh (60%)

- Saline area 1.06 mha
- Drought prone 3.5 mha
- Waterlogged 2.6 mha
- Charland 0.83 mha
- Haor 0.25 mha
Different tillage techniques

Minimum tillage

Strip tillage

Bed planting

Zero tillage
1. Minimum tillage by power tiller operated seeder

- Shallow tilling, line seeding, fertilizing and seed covering at a time

Conventional 3-4 ploughing pass, seed broadcasting & laddering

- Working as shallow tilling, fertilizing, seeding in line, seed covering at a time
- Residual soil moisture using for seeding
- Uniform depth of seeding
- Easy planting
- Seed saving 20%, cost saving 67%
- Wheat, maize, pulses, jute, rice, oilseeds can be sown successfully
Wheat seeding in farmers Field

- Better seed-soil contact
- Number of tiller more & optimum plant population
- Crop yield 10-15 % more than con.
- Working capacity: 0.13 ha/h
- Local manufacturer can fabricate
• Mungbean planting rice-wheat cropping system

• Farmers can harvest it as bonus crop as crop duration minimum
Different seed sowing by the same seeder

• Plate need to change as per seed size
Rice direct seeding by seeder

- Dry direct seeding (DSR)
- Seed rate: 25 kg/ha
- 9-11 days early maturity
- Water saving avoiding puddling operation

- Roundup herbicide used before 3 days of seeding
- Herbicide sprayed after seeding at moist condition (after 6-24 hrs)
- One hand weeding after 35 days
### Cost of rice production under different tillage at Rajshahi

<table>
<thead>
<tr>
<th>Nodes</th>
<th>Treat.</th>
<th>Production cost (Taka ha⁻¹)</th>
<th>Gross return (Taka ha⁻¹)</th>
<th>Net profit (Taka ha⁻¹)</th>
<th>Labour use (nos.)</th>
<th>% Labour saving over PTPR</th>
<th>Growth duration (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dharampur</td>
<td>DSR</td>
<td>37161</td>
<td>86360</td>
<td>49200</td>
<td>53</td>
<td>46</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>UTPR</td>
<td>45624</td>
<td>102442</td>
<td>56818</td>
<td>82</td>
<td>17</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>PTPR</td>
<td>46620</td>
<td>100765</td>
<td>54146</td>
<td>99</td>
<td>-</td>
<td>123</td>
</tr>
<tr>
<td>Baduria</td>
<td>DSR</td>
<td>36652</td>
<td>97943</td>
<td>61290</td>
<td>52</td>
<td>51</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>UTPR</td>
<td>46005</td>
<td>104289</td>
<td>58285</td>
<td>86</td>
<td>20</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>PTPR</td>
<td>48590</td>
<td>103863</td>
<td>55274</td>
<td>107</td>
<td>-</td>
<td>118</td>
</tr>
</tbody>
</table>

- **DSR-Labour saving:** 50%, **Cost saving:** 20-25%
### Average Crop Yield 2015-16

<table>
<thead>
<tr>
<th>Planting methods</th>
<th>Average yield, t/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wheat</td>
</tr>
<tr>
<td>Minimum tillage by the seeder</td>
<td>3.9</td>
</tr>
<tr>
<td>Farmer’s practice</td>
<td>2.9</td>
</tr>
</tbody>
</table>

**Crop Types:**
- Wheat
- Mung
- Lentil
- Maize
- Rice
Long term yield trend under minimum till

- Crop rotation: Wheat- Mungbean-Rice
- Last 6 years, wheat, mung yield shows always higher than conventional
2. Strip till

Seeding, fertilizing and seed covering simultaneously—one operation

- Making a narrow strip and work through moderate level residue, 4-6 cm
- Fine till the strip
- Uniform depth of seed placement, 5-7 cm
- Un-till between the seeding line

- Seed & fertilizer unit separate
- Use as both strip till and minimum till
- Can handle maize and other small seeds efficiently

- Seed & fertilizer unit separate
Crop establishment by strip tillage

- Tilling, seeding in line, fertilizing and seed covering at a time
- Utilize residual soil moisture
- Reduce turn around time (7-9 days)
- Multicrops seeding (wheat, maize, rice, pulses, jute, sesame, onion etc)
- Save seed: 29%
- Save planting cost: 62%
3. Bed planting

**Advantages**

- Less seed
- Less water
- Less labor
- Less crop damage (*rats, pests, diseases*)
- Less production cost
- Higher yields
- Higher economic returns
- Facilitate crop diversification
- Increased agricultural sustainability
Bed planting: Water saving technology

Advantages of bed planting

- Easy irrigation and minimum water loss
- Less amount urea required
- Less lodging tendency of crop
- Easy management and overcome water lodging problem
- Crop survive in medium level salinity
Wheat establishment by bed planter

- Tilling, Bed formation & seeding on bed at a time
- Two lines wheat per bed
- Utilize residual soil moisture for crop establishment
- Minimize turn around time between the two crops

Wheat Yield: 4.5 t/ha
Conventional method: 3.5 t/ha
Mungbean after wheat

- Mungbean seeding on same bed after wheat harvest
- Successive crop grown keeping bed permanent

Mungbean survive on bed in case of waterlogging condition
Maize planting after potato

- Land preparation, fertilizing, planting on bed and earthing up at a time.
- **No need additional earthingup**
- Single line per bed
- Bed formation capacity: 1 bigha/hr (33 Decimal per hr) (0.12 ha per hr)

**Cost and labour saving: 60%**
Lentil on bed system

- Bed formation & seeding at a time
- Two lines per bed
- Seed rate: 25 kg/ha
- Planting: 20-28 Nov 2015

Lentil Yield: 1.2 t/ha
Conventional method: 0.8 t/ha
Vegetables on Beds System

- Radish
- Coriander
- Amaranth

- Crops survive water log condition
- More yield compared to flat planting
Efficient irrigation water application

- Minimize water loss
- Less labour involvement for irrigation
  - Faster irrigation
  - Water saving: 31%

<table>
<thead>
<tr>
<th>Method of planting</th>
<th>Wheat cultivation</th>
<th>Maize cultivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Irrig. Time/irri (hrs)/ha</td>
<td>No. irrigation</td>
</tr>
<tr>
<td>Bed planting new bed method</td>
<td>6.6</td>
<td>3</td>
</tr>
<tr>
<td>Permanent bed</td>
<td>5.4</td>
<td>3</td>
</tr>
<tr>
<td>Conv. method</td>
<td>8.25</td>
<td>3</td>
</tr>
</tbody>
</table>
Yield advantages of bed planting

<table>
<thead>
<tr>
<th>Season</th>
<th>Crop</th>
<th>No. of Trials</th>
<th>Yield Increase with Beds %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabi</td>
<td>Wheat</td>
<td>497</td>
<td>13-18</td>
</tr>
<tr>
<td>Kharif-1</td>
<td>Mungbean</td>
<td>121</td>
<td>25-30</td>
</tr>
<tr>
<td></td>
<td>Lentil</td>
<td>64</td>
<td>21-42</td>
</tr>
<tr>
<td></td>
<td>Jute</td>
<td>33</td>
<td>13-22</td>
</tr>
<tr>
<td></td>
<td>Maize</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Sesame</td>
<td>19</td>
<td>16-37</td>
</tr>
<tr>
<td></td>
<td>Groundnut</td>
<td>3</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>Potato</td>
<td>19</td>
<td>8-33</td>
</tr>
<tr>
<td>Kharif-2</td>
<td>Rice</td>
<td>208</td>
<td>5-19</td>
</tr>
</tbody>
</table>
# Wheat yield and cost of seeding

<table>
<thead>
<tr>
<th>Planting methods</th>
<th>Average yield, t/ha</th>
<th>Cost of planting (Tk./ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wheat</td>
<td>Mungbean</td>
</tr>
<tr>
<td>PTOS/minimum till</td>
<td>4.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Strip till</td>
<td>4.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Farmer’s practice</td>
<td>3.5</td>
<td>0.75</td>
</tr>
</tbody>
</table>

• PTOS saved :61.7% planting cost
Table 2. Area under conservation agriculture tillage system in Bangladesh

<table>
<thead>
<tr>
<th>Name of conservation agriculture tillage techniques</th>
<th>2010-11 (ha)</th>
<th>2011-12 (ha)</th>
<th>2012-13 (ha)</th>
<th>2013-14 (ha)</th>
<th>2014-15 (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum tillage</td>
<td>9864</td>
<td>17527</td>
<td>29225</td>
<td>31155</td>
<td>32205</td>
</tr>
<tr>
<td>Strip tillage</td>
<td>72</td>
<td>106</td>
<td>108</td>
<td>225</td>
<td>300</td>
</tr>
<tr>
<td>Zero tillage</td>
<td>79</td>
<td>59</td>
<td>97</td>
<td>105</td>
<td>110</td>
</tr>
<tr>
<td>Bed planting system</td>
<td>4337</td>
<td>4636</td>
<td>5745</td>
<td>5950</td>
<td>6350</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14352</strong></td>
<td><strong>22328</strong></td>
<td><strong>35175</strong></td>
<td><strong>37435</strong></td>
<td><strong>38965</strong></td>
</tr>
</tbody>
</table>
Adaption of Minimum tillage Technologies Bangladesh

Number of active PTOS

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of PTOS</th>
<th>Area coverage (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-00</td>
<td>1200</td>
<td>0</td>
</tr>
<tr>
<td>2000-01</td>
<td>900</td>
<td>0</td>
</tr>
<tr>
<td>2001-02</td>
<td>940</td>
<td>0</td>
</tr>
<tr>
<td>2002-03</td>
<td>980</td>
<td>0</td>
</tr>
<tr>
<td>2003-04</td>
<td>1020</td>
<td>0</td>
</tr>
<tr>
<td>2004-05</td>
<td>1060</td>
<td>0</td>
</tr>
<tr>
<td>2005-06</td>
<td>1100</td>
<td>0</td>
</tr>
<tr>
<td>2006-07</td>
<td>1140</td>
<td>0</td>
</tr>
<tr>
<td>2007-08</td>
<td>1180</td>
<td>0</td>
</tr>
<tr>
<td>2008-09</td>
<td>1220</td>
<td>0</td>
</tr>
<tr>
<td>2009-10</td>
<td>1260</td>
<td>0</td>
</tr>
<tr>
<td>2010-11</td>
<td>1300</td>
<td>0</td>
</tr>
<tr>
<td>2011-12</td>
<td>1340</td>
<td>0</td>
</tr>
<tr>
<td>2012-13</td>
<td>1380</td>
<td>0</td>
</tr>
<tr>
<td>2013-14</td>
<td>1420</td>
<td>0</td>
</tr>
<tr>
<td>2014-15</td>
<td>1460</td>
<td>0</td>
</tr>
</tbody>
</table>

The 4th Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific
Table 3. Yield comparison of major crops under CA tillage systems

<table>
<thead>
<tr>
<th>Conservation agriculture system</th>
<th>2012-13 (t/ha)</th>
<th></th>
<th>2013-14 (t/ha)</th>
<th></th>
<th>2014-15 (t/ha)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wheat</td>
<td>maize</td>
<td>Mung bean</td>
<td>Wheat</td>
<td>maize</td>
<td>Mung bean</td>
</tr>
<tr>
<td>Minimum tillage</td>
<td>4.7</td>
<td>9.5</td>
<td>1.3</td>
<td>4.5</td>
<td>9.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Strip tillage</td>
<td>5.2</td>
<td>9.3</td>
<td>1.2</td>
<td>4.6</td>
<td>8.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Zero till</td>
<td>4.4</td>
<td>8.8</td>
<td>1.2</td>
<td>4.1</td>
<td>8.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Bed planting</td>
<td>5.2</td>
<td>9.7</td>
<td>1.0</td>
<td>4.8</td>
<td>8.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Conventional system</td>
<td>3.5</td>
<td>9.0</td>
<td>0.7</td>
<td>3.6</td>
<td>8.3</td>
<td>0.75</td>
</tr>
</tbody>
</table>
### Table 4. Cost of planting in different CA tillage system over conventional methods

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Seeding methods</th>
<th>Cost of seeding (Tk./ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimum tillage</td>
<td>1950.0</td>
</tr>
<tr>
<td>2</td>
<td>Strip tillage</td>
<td>1850.0</td>
</tr>
<tr>
<td>3</td>
<td>Zero tillage</td>
<td>1740.0</td>
</tr>
<tr>
<td>4</td>
<td>Bed planting system</td>
<td>3394.0</td>
</tr>
<tr>
<td>5</td>
<td>Conventional method</td>
<td>5695.0</td>
</tr>
</tbody>
</table>
### Table 5. Comparative use of diesel fuel on conventional and reduced tillage method

<table>
<thead>
<tr>
<th>Tillage option</th>
<th>Diesel used (lit./ha/yr)</th>
<th>CO$_2$ emission (kg/ha/yr)*</th>
<th>Fuel save (lit./ha/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA system</td>
<td>119</td>
<td>309.4</td>
<td>94</td>
</tr>
<tr>
<td>Traditional method</td>
<td>213</td>
<td>553.8</td>
<td></td>
</tr>
</tbody>
</table>

Hossain et al., 2009; *1 kg diesel produced 2.6 kg CO$_2$
Problems of CA technology adoption

• Policy planners are not much convince about these technology
• Uncertain machinery demand
• Manufacturing infrastructure and distribution channels of products are little developed
• High price of machinery and low prices of agricultural produce discourage investments.
Problems of CA technology adoption (Cont.)

- Financial organizations are not much friendly to farmers in terms of reducing rate of interest and installments.
- Absentee farmer and small landholder limited access to new technology
- Research–extension-farmers linkage are not well established about these technology transfer
- Limited promotional activity and awareness build up program.
Challenges promotion of CA technology

• Changing mind set up of the users for CA technology
• Motivation private sector investment for scaling up these technology
• How to make available appropriate CA implements and tools at an affordable price to farmers
• Training needed in different level of workers, about the advantages of conservation agriculture
• Policy support is necessary for further acceleration of this technology among the users.
Recommandations

- CO$_2$ emission is 44% less than conventional tillage system
- Appropriate CA technologies are available, can be used in different farm size and ecosystem
- Several prototypes of power tiller operated implements have been already developed and presently require commercial production.
- Government is friendly to farmers supporting with subsidized rate machinery application in agriculture
- Bed planting systems are more popular in Rajshahi Bangladesh.
- Farmers accept this technology and service providers started commercial business with the CA planters.
Thank You Very Much.............

Name : DR. SULTAN AHMMED  
Email Address: s.ahmmed@barc.gov.bd 
    md-nrm@barc.gov.bd 
Website: www.barc.gov.bd