Combating Air Pollution from Biomass Burning through Mechanization Solutions for Integrated Straw Management

Mechanization-based Solutions: Perspectives from Nepal

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Outline of the Presentation

Overview

Results from baseline survey

Mechanized based interventions

Results from field trials/tests

Training of operators and awareness generation amongst farmers

Key achievements/benefits

Key learnings and recommendations
Overview

- Agriculture contributes 15.44% in Gross Domestic Product (GDP) in 2019-20
- Out of which Cereal and other crops = 8.49%, out of which
  - paddy and straw= 15.35%
  - maize and straw= 8.85%
  - wheat and straw= 6.34%
- Paddy is the most widely cultivated crop in Nepal, followed by Maize then wheat, Production of grain and straw 2019-20 (MOALD, 2020)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Grain Yield million MT</th>
<th>Straw Grain Ratio</th>
<th>Straw Yield million MT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy</td>
<td>5.5</td>
<td>1.1</td>
<td>6.05</td>
</tr>
<tr>
<td>Maize</td>
<td>2.8</td>
<td>1.14</td>
<td>3.19</td>
</tr>
<tr>
<td>Wheat</td>
<td>2.1</td>
<td>1.09</td>
<td>2.29</td>
</tr>
</tbody>
</table>

- Straw burning has started and expanding after use of combine harvester. Exact data is not available at recent stage.
Overview

Pilot Site

- Krishna Daana Udhyog (KDU), Gramthan RMC, Morang District.
  - It is a Feed industry working as a stakeholder as pilot demonstration site.
  - It compresses straw block with added nutrients for livestock feed (ex-situ straw management).
  - Agricultural Farm (In-situ straw management).

Figure 1: Map showing demonstration site (KDU).
Results from baseline survey

**Figure 2:** Gender-wise survey participants (Total: 111).

**Figure 3:** Map showing survey location.

**Figure 4:** Paddy straw uses by farmers.

**Figure 5:** Reasons of Paddy straw burning.
Mechanization-based interventions

In-situ mechanization-based interventions

**Happy/Super seeder**
- Super Seeder – one pass sowing solution, incorporate paddy straw & stubbles into soil, and simultaneously sow seeds.
- Reduce the time required for soil preparation and help to meet the season.
- Reduce production cost and increases profit.

**Mulcher**
- Mulcher – Cuts paddy stubbles into small pieces and covers the soil to preserve moisture.
- Incorporation will increases the organic content in the soil.
Mechanization-based interventions

Pilot field condition super seeder vs traditional

- Left Side control plot (traditional) & Right side (super seeder)
- Crop statue of 66 days after sowing - 6th Feb 2023
Mechanization-based interventions

In-situ mechanization-based interventions

**Drum Seeder**

- Drum seeder – Resource conservation technology, which reduces rice plantation time and labours, and also the overall crop harvesting time.
- Save time and money.
- Easy to operate and low cost technology.
Mechanization-based interventions

**Ex-situ mechanization-based interventions**

**DTMR Block making machine**
- DTMR Block making machine – compress and make straw block with added nutrients.
- Increases the density so reduces the storage space, ease bulk transportation and reduce cost.
- Reduce production cost and increases profit.

**Straw Baler**
- Straw baler - compress a cut and raked crop residue into compact bales that are easy to handle, transport, and store.
- Clears the soil and prepares it for the sowing of the next crop, and provides secondary income for the farmer.
Results from field trials/test

**Table 2:** Organic content and net nitrogen content of soil in control & experimental plot at 15 cm from the surface in 2 crop cycle

<table>
<thead>
<tr>
<th>Soil Sample</th>
<th>Before Wheat Sowing (2021 Dec)</th>
<th>After Harvesting Rice (2022 Nov)</th>
<th>Increased by (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OM (%)</td>
<td>Net Nitrogen (%)</td>
<td>OM (%)</td>
</tr>
<tr>
<td>Control plot</td>
<td>1.43</td>
<td>0.07</td>
<td>4.15</td>
</tr>
<tr>
<td>Experimental plot</td>
<td>1.48</td>
<td>0.073</td>
<td>3.53</td>
</tr>
</tbody>
</table>

**Table 3:** Yield and B/C ratio of wheat and paddy production in control & experimental plot

<table>
<thead>
<tr>
<th>Plot</th>
<th>Wheat</th>
<th>Paddy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield (kg/ha)</td>
<td>B/C ratio</td>
</tr>
<tr>
<td>Control plot</td>
<td>2,719.00</td>
<td>1.07</td>
</tr>
<tr>
<td>Experimental plot</td>
<td>2,721.50</td>
<td>1.62</td>
</tr>
</tbody>
</table>
Training and Awareness generation

Table 4: Farmers number in 3 awareness events

<table>
<thead>
<tr>
<th>Sessions</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>50</td>
<td>12</td>
<td>62</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>54</td>
<td>08</td>
<td>62</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>37</td>
<td>33</td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td>141</td>
<td>53</td>
<td>194</td>
</tr>
</tbody>
</table>

Figure 6: Training participants: local & outstations

Figure 7: Participants in awareness events
Key achievements/benefits

• Farmers were made aware of straw burning consequences and the economic benefits of valorization.
• Training tractor operators on new in-situ & ex-situ machinery was effective for smooth operation and maintenance but longer training is needed. Represented cooperatives are willing to buy such machine.
• In-situ machineries, Super Seeder and Mulcher, were added in the pilot sites.
• Cost of production by labour saving DTMR block was reduced by adding of auxiliary machines and arranging proper production flow.
• Demonstration of newly purchased super-seeder for in-situ management of straw in wheat cultivation was highly appreciated by farmers, researchers and extension workers.
• Government stakeholders are convinced with Super seeder for in-situ straw management, DOAR, Tarahara is planning to purchase one unit for vigorous trials and demonstration.
• Surrounding farmers of Pilot site will be adopting Super seeder wheat cultivation, but more machines are needed for mass replication.
Key learnings & recommendations

Key recommendations

- Use of minimum-tillage seeder for wheat cropping is highly recommended for both straw management and economic perspectives.

- Ex-situ management of straw using DTMR block increases the density by compaction and hence lowers the storage and transportation costs.

- Proper government planning & strategies is needed to discourage straw burning and encourage straw based industries.

- Organic content of the Nepalese soils are degrading so proper in-situ residue management is necessary to improve the soil quality and hence the productivity.

- Further replication and expansion of the pilot is needed to draw more conclusions on the improvement of soil condition, and strengthen efforts to convince the farmers to adopt new concept or new technologies.
THANK YOU!

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