Implementation of the Pilot Project on Integrated Straw Management in China

Dr. He Jin, Professor

China Institute for Conservation Tillage, China Agricultural University
Conservation Tillage Research Center, MoA, P. R. China
Acknowledgements

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- Administration of Agriculture and Rural Affairs, Qingdao
- Administration of Agriculture and Rural Affairs, Laixi
- Qingdao Zhitao Agricultural Machinery Specialized Cooperative
- Partners from other pilots
Outline

- Straw burning problems in China
- Policy arrangement
- Mechanization solutions
- Main challenges
Section I: Straw burning problems in China
Total quantity of crop straw in China: >800 million tons/year. (Source: Ministry of Agriculture and Rural Affairs, P.R. China, 2018)
Straw burning causes many environmental problems:

A large amount of straw was burned because of inefficient management, poor awareness of farmer and scarce policy.

- Air pollution
- Water pollution
- Fire hazard
- Biomass energy waste…
The State Council, P. R. China issued the policies related to “Straw Management” to accelerate integrated crop straw management in China.

<table>
<thead>
<tr>
<th>Document</th>
<th>Department</th>
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<tbody>
<tr>
<td>2007 Central NO.1 Document</td>
<td>The State Council, P.R.China</td>
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<tr>
<td>2008 Central NO.1 Document</td>
<td>The State Council, P.R.China</td>
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<tr>
<td>Opinions on accelerating the comprehensive utilization of crop straw</td>
<td>The State Council, P.R.China</td>
</tr>
<tr>
<td>2017 Central NO.1 Document</td>
<td>The State Council, P.R.China</td>
</tr>
<tr>
<td>2018 Central NO.1 Document</td>
<td>The State Council, P.R.China</td>
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</table>
National Ministries and local government also issued a lot of policies to prohibit “straw burning” and improve environment quality and sustainable development.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Focused 50 technologies on “10th Five-year plan” (2001)</td>
<td>Ministry of Agriculture and Rural Affairs, P.R.China</td>
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<tr>
<td>Notice on strengthening prohibition of straw burning and comprehensive utilization of straw (2003)</td>
<td>Ministry of Ecology and Environment , P.R.China</td>
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<tr>
<td>Notice on “12th Five-year plan” for integrated straw (2011)</td>
<td>National Development and Reform Commission, P.R.China</td>
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<tr>
<td>Notice on Adjusting and Improving the Tax Reduction Policies for Comprehensive Utilization of Straw Products (2011)</td>
<td>Ministry of Finance, P.R.China</td>
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<tr>
<td>Notice on extension of the Comprehensive Utilization and Prohibition of Crop Straw (2013)</td>
<td>National Development and Reform Commission,, P.R.China</td>
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<tr>
<td>Notice on Accelerating the Comprehensive Utilization and Prohibition of Crop Straw (2015)</td>
<td>National Development and Reform Commission,, P.R.China</td>
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<tr>
<td>Notice on extension of the Prohibition of Crop Straw (2018)</td>
<td>Ministry of Agriculture and Rural Affairs, P.R.China; Ministry of Ecology and Environment , P.R.China</td>
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Section III: Mechanization solutions

Mechanization plays an important role in straw utilization management
1. Fertilizer

2. Fodder

Integrated Straw Management

3. New energy resources

4. Base stock

5. Industry material
1. Fertilizer

◆ Direct straw returning

Crop harvest → straw chopping and mulching → no-till seeding

- Mechanization promotes harvesting and sowing efficiency
◆ Cow manure returning

Composting → fertilizer spreading → no-tillage seeding

- Mechanization increased composting efficiency and planting performance
2. Fodder

Maize harvesting $\rightarrow$ straw storage and fermentation $\rightarrow$ feeding cow

- Mechanization improves quality and palatability of fodder.
3. New energy resource

Manure → composting and fermentation → produce biogas →
heating supply and cooking

- Mechanization improves biogas production efficiency and new energy utilization.
4. Base stock
Material reserving → fermentation → planting → fungi management → harvest

5. Industry material
Smash → infiltration → calcify → continuous cook → straw pulp → decoloration → homogenate → compression → coating → molding → incision → package → products

Related machines are widely used in straw management as base stock and industry material.
Project “Pilots of Integrated Straw Management in China”

Establish the pilot site in Laixi (2019-2022)
Objective 1: **Develop** an integrated straw management

Objective 2: Establish demonstration site in Laixi

Objective 3: **Technical trainings** on integrated straw management technology

Objective 4: **Extension** of straw management technologies
The three main crops (Wheat, Maize and Peanut) annually produce >800 thousand tons of straws. It’s a great challenge for Laixi!
What we have done (Jul. 2019-Oct. 2020)

- Selection and implementation of technical patterns
- Results and Outcomes
Selection and implementation of technical pattern

Straw used as fertilizer

Straw used as folder

Straw used as new energy resource

Returning straw to the field
Returning cow manure to the field
Returning biogas residue to the field (this year)
Ensilage maize

Biogas production (this year)
1. Straw used as fertilizer

Returning straw to the field

Wheat harvesting and straw chopping → Maize no-till planting → Maize harvesting → Straw chopping

Maize straw as organic fertilizer → Sprinkling irrigation → Minimum tillage seeding of wheat
Returning cow manure to the field

Feeding cows

Cow manure composting

Minimum tillage seeding of wheat

Returning cow manure to the field
2. Straw used as fodder

Ensilage maize

Maize harvesting

Straw fermentation

Feeding cows

Processing fodder
3. Straw used as new energy resource

Biogas production (this year)

- Produce biogas (under construction)

Returning biogas residue to the field (this year)

- Separation of biogas and biogas residue
- Returning biogas residue to the field
## Results and Outcomes

### Ecological Indicators

<table>
<thead>
<tr>
<th>Item</th>
<th>Returning straw to the field</th>
<th>Returning cow manure to the field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil organic matter (%)</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Straw burning reduction (tons/ha)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter wheat straw</td>
<td>6.93 (in the growing stage of summer maize)</td>
<td>-</td>
</tr>
<tr>
<td>Summer maize straw</td>
<td>8.80 (in the growing state of winter wheat)</td>
<td>-</td>
</tr>
<tr>
<td>Cow manure returned to the field (tons/ha)</td>
<td>-</td>
<td>70.25</td>
</tr>
</tbody>
</table>

The demonstration achieved improvements in ecological aspects:

1. **Soil organic matter** was 2.1% and 2.1% in the field with the management of straw returning and cow manure returning, respectively;

2. The **reduction** in burning of winter wheat and summer maize straw were **48.51** and **61.60 tons** in the demonstration site (7 ha), respectively;

3. **70.25 tons/ha cow manure** (total 491.75 tons) was returned to the field in the demonstration site (7 ha).
<table>
<thead>
<tr>
<th>Indicators</th>
<th>Management method</th>
<th>Item</th>
<th>Wheat</th>
<th>Maize</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Initial value (before the project, 2018)</td>
<td>Value (Jun. 2020)</td>
<td>Initial value (before the project, 2018)</td>
</tr>
<tr>
<td>Yield production</td>
<td>Returning straw to the field</td>
<td>Yield (kg/ha)</td>
<td>7,100</td>
<td>7,334</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input USD/ha)</td>
<td>649</td>
<td>642</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output (USD/ha)</td>
<td>2,414</td>
<td>2,493</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Net income (USD/ha)</td>
<td>1,765</td>
<td>1,851</td>
</tr>
<tr>
<td></td>
<td>Returning cow manure to the field</td>
<td>Yield (kg/ha)</td>
<td>7,100</td>
<td>7,425</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input USD/ha)</td>
<td>649</td>
<td>642</td>
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<td>Output (USD/ha)</td>
<td>2,414</td>
<td>2,524</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Net income (USD/ha)</td>
<td>1,765</td>
<td>1,882</td>
</tr>
<tr>
<td>Milk production</td>
<td>Ensilage maize</td>
<td>Milk production (ltr/day/cow)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Milk value (USD/day)</td>
<td>1,068</td>
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</table>

The demonstration achieved improvements in economic aspects:
1. The net income with the improved technical modes of returning straw to the field and returning cow manure to the field was **157 USD/ha** and **386 USD/ha**, respectively;
2. The milk value was increased by **53 USD/day** for total **100 cows** (only 100 out of 400 cows can produce milk) as compared to traditional fodder in the demonstration site.
Section IV: Main challenges
Government support

Promulgate Policies:
• Cooperation of National departments
• Subsidy policy of agricultural machinery purchase
• Subsidy policy of machinery operation
• …..

Promotion of straw utilization:
• Demonstration of integrated straw management
• Demonstration based on local conditions
• …..
Improve equipment

Returning straw to the field/
Returning cow manure to the field

Improve no-till seeder quality

Returning cow manure to the field

Using pollutant discharge pipe
Integrated Straw Management

- Poor working performance
- Lower utilization efficiency of straw
- ...

Suitable technical pattern

Fertilizer  Fodder  New energy

Improve performance of integrated straw management
Optimization of technical pattern
Enhance awareness of farmers

Class training

Field tour

Discussion

Improve the technical level of local technicians and farmers in integrated straw utilization
Welcome to visit Laixi demonstration site in China!

Thanks!