Implementation of the Pilot Project on Integrated Straw Management in China

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CSAM Pilot Project on Integrated Straw Management in China
联合国可持续农业机械化中心秸秆综合利用中国试点项目

**Project Period:** 2018-2021
**项目周期:** 2018-2021

**Project Objectives:**
1) to develop an innovative, circular and green model of integrated straw management for using straw residue as fertilizer, fodder and for green energy production; 2) to enhance awareness of farmers and other key stakeholders on technologies and models for integrated straw management; 3) to upscale the application of successful integrated straw management technologies and models.

**项目目标:**
1) 总结一套创新、循环和绿色的秸秆综合利用模式，将秸秆用于肥料、饲料和绿色能源生产；2) 提高当地农民和其他关键利益相关者对秸秆综合利用模式的认识；3) 推广秸秆综合利用模式的应用范围。

**Project Partners**
Centre for Sustainable Agricultural Mechanization (ESCAP-CSAM)
China Agricultural University
Conservation Tillage Research Centre, Ministry of Agriculture and Rural Affairs, China
Qingdao Administration of Agriculture and Rural Affairs
Laixi Administration of Agriculture and Rural Affairs

**Demonstration Site Partner (Laixi, Qingdao)**
Qingdao Zhitao Agricultural Machinery Specialized Cooperative

**China Agricultural University**

**Qingdao Administration of Agriculture and Rural Affairs**

**Laixi Administration of Agriculture and Rural Affairs**

**Qingdao Zhitao Agricultural Machinery Specialized Cooperative**
Outline

I. Overview of straw management in China

II. Technical interventions and models implemented

III. Machinery modifications made

IV. Training and awareness generation amongst farmers

V. Key achievements and benefits

VI. Recommendations
1. Overview of straw management in China

High straw yield in China

- Totally, the annual yield of crop straw is >900 million tons;
- The annual straw yields of rice, wheat and maize are >210, 130 and 260 million tons, respectively.
1. Overview of straw management in China

1. Fertilizer
2. Fodder
3. New energy resources
4. Base material
5. Industry material

- In general, we use five methods to prohibit straw burning/discarding;
- In 2021, the comprehensive utilization rate of agricultural straw reached 88.1% in China.
2. Technical interventions and models implemented at the pilot site

- Three main crops (Wheat, Maize and Peanut) annually produce >800 thousand tons of straws;
- The project was carried out in **Laixi, Qingdao** from 2019 to 2022.
2. Technical interventions and models implemented at the pilot site

1. Fertilizer

Straw is used as raw materials to cultivate mushroom

2. Fodder

Crop straw is used as fertilizer, mainly includes returning straw/cow manure/biogas slurry to the field

Crop straw is collected and processed to make fodder

3. New energy resources

The combustible gas generated in the process of straw fermentation is used for heating or other domestic purposes

4. Base material

Integrated Straw Management
The straw should be *evenly* chopped and returned to soils to facilitate subsequent no-tillage seeding;

- Seeding depth needs to be uniform for good germination of wheat and maize;
- Also, subsoiling can be used every 2-3 years according to soil conditions.
Wheat harvesting and Straw chopping

No tillage seeding of maize

Maize harvesting and Straw chopping

Wheat seeding

Maize straw mixing with soils

*Fertilizer*

(2) Returning straw to the field - *Straw mixing with soils*

- The chopped maize straw needs to be fully mixed with soils, so as to improve wheat germination after seeding;
- Others operations are the same as straw cover.
For cow feeding, the fodder needs to be used layer by layer to prevent contamination;
For returning cow manure to the field, the cow manure should be mixed with soils evenly.
*Fertilizer*

④ Returning biogas slurry to the field

- Straw (cow manure) preparation
- Pre-mixing
- Biogas fermentation
- Separation of biogas residue and slurry
- Wheat seeding
- Mixing biogas slurry with soils
- Returning biogas slurry to the field

- Professional vehicle transportation, no leakage and overflow;
- Biogas slurry should be fully mixed with soils to get good fertilizer effect.
To improve the palatability and digestibility of fodder, the maize straw should be chopped finely;

Anaerobic digestion should be carried out to improve fodder quality;

Environment for feeding cows and producing milk should be kept clean and hygienic.
*New Energy Resources*

**Biogas Production**

- Straw preparation
- Biogas fermentation and production
- Usage
- Biogas transportation
- Processing

- The raw materials are placed in an anaerobic environment for biogas fermentation and production, and then biogas is chemically desulfurized;
- Air convection is required to dilute biogas and other gases before the maintenance of biogas pool.
Mushroom harvesting: Cleaning and disinfecting the workers’ hands. Timely packaging and harvesting.
3. Machinery modifications made

**Improved technical mode of returning straw to the field**

- Straw chopping
- Straw chopping and mixing with soil
- Improve maize no-till seeding quality

**Improved technical mode of returning cow manure to the field**

- Sewage disposal through cow manure
- Addition of Dry-wet cow manure separation
- Addition of plastic film cover fermentation and Ten-stage sedimentation tank
3. Machinery modifications made

**Improved technical mode of returning biogas slurry to the field**

- Pre-mixing

- Addition of dry-wet biogas slurry and biogas residue separation

**Improved technical mode of ensilage maize**

- Feeding cow

- Addition of mechanized straw kneading

- Addition of catalytic enzyme
4. Training and awareness generation amongst farmers

Technical training

- Training course on integrated straw management to enhance awareness and technical skills of straw management (2021, 2022).
4. Training and awareness generation amongst farmers

Virtual Workshop and Demonstration

- The Virtual Workshop and Demonstration were organized to share the good practices and experiences.
- Experts from China, India, Laos, Thailand, Cambodia, Indonesia, Nepal and Viet Nam shared knowledge and experience on straw residue management.
5. Key achievements/benefits

Circular agriculture model

- Farm Land (Return straw as fertilizer)
  - Straw as fodder
  - Fertilizer from biogas residue and slurry

- Biogas Digester
  - Manure for biogas production
  - Methane for cooking and lighting

- Dairy Farm
  - Straw as fodder
  - Fermented manure as fertilizer

- Community
  - Mushroom Cultivation
  - Straw as base material
The demonstration achieved improvements in ecological aspects:

1. In the field with the management of straw cover, straw mixing, cow manure returning, biogas slurry/residue returning, soil organic matter was increased to 2.31%, 2.3%, 2.34%, 2.36%;
2. 345 tons of straw were utilized per year rather than burnt;
3. 70.25 tons of cow manure were returned to the field as organic fertilizer per ha.
1. The maize and wheat **yields** were increased in the four treatments;

2. **Milk production** for the new fodder with catalytic enzyme was 3 ltr/day/cow (24.0 vs 21.0 ltr/day/cow) higher than the fodder in the first year;

3. 90,000m³ of **biogas** were produced every year;

4. **Mushroom cultivation**: Each greenhouse can produce 18 tons of mushrooms every year, with a total revenue of about 58 thousand US dollar.
6. Recommendations

- Promulgate related policy and provide subsidies
- Promote technology and strengthen technical patterns according to local conditions
- Research, develop, and optimize machinery
- Strengthen training and demonstrations
Welcome to visit Laixi, Qingdao demonstration site in China!