Implementation of the Pilot Project on Integrated Straw Management in China

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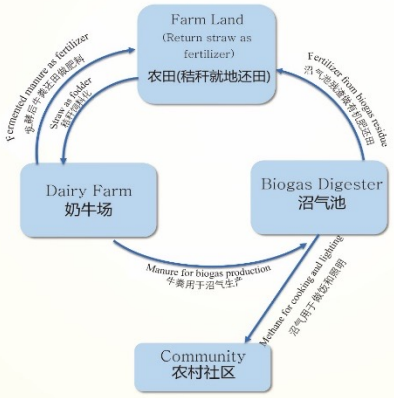
CSAM

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、可循环、绿色秸秆综合利用模式，将秸秆用于肥料、饲料和绿色能源生产；2）提升当地农民及其他相关人员对试点秸秆综合利用模式的认识；3）推广试点秸秆综合利用模式的应用范围。



Technologies and models for pilot project
试点技术模式：

Returning straw to the field: straw chopping – straw mulching – decomposition of straw to serve as organic fertilizer.
秸秆还田：秸秆粉碎 – 秸秆覆盖 – 秸秆分解为有机肥

Fodder for cattle: collection of maize straw – straw composting and storage in ensilage digester – straw fermentation – mixing fermented straw with other ingredients – feeding cattle.
秸秆用于饲料：收集玉米秸秆 – 秸秆堆肥、存储于青贮窖 – 秸秆发酵 – 发酵秸秆与其他饲料混合为奶牛饲料

Returning cow manure to the field: collection of cow manure and composting – return of cow manure to field as organic fertilizer.
牛粪肥还田：收集牛粪并堆肥 – 发酵牛粪为有机肥还田

Producing biogas: collection of cow manure – manure fermentation in biogas digester – supplying biogas to farmers via pipes.
秸秆用于沼气生产：收集牛粪 – 牛粪沼气池发酵 – 沼气通过管道供给农民使用

Returning biogas residue to the field: production of organic fertilizer from biogas waste – returning of biogas waste to the field.
沼气池残渣还田：沼气池残渣生产有机肥 – 有机肥还田

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

项目单位
联合国可持续农业机械化中心
中国农业大学
中国农业农村部保护性耕作研究中心
青岛市农业农村局
莱西市农业农村局

示范点 (青岛-莱西)
青岛志涛农机专业合作社

SUSTAINABLE DEVELOPMENT GOALS

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

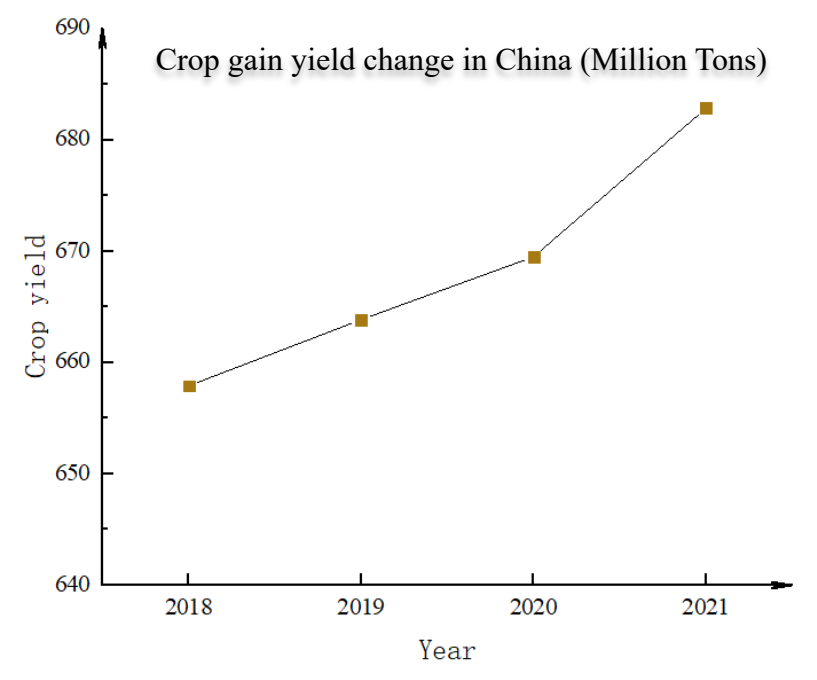
IV Training and awareness generation amongst farmers

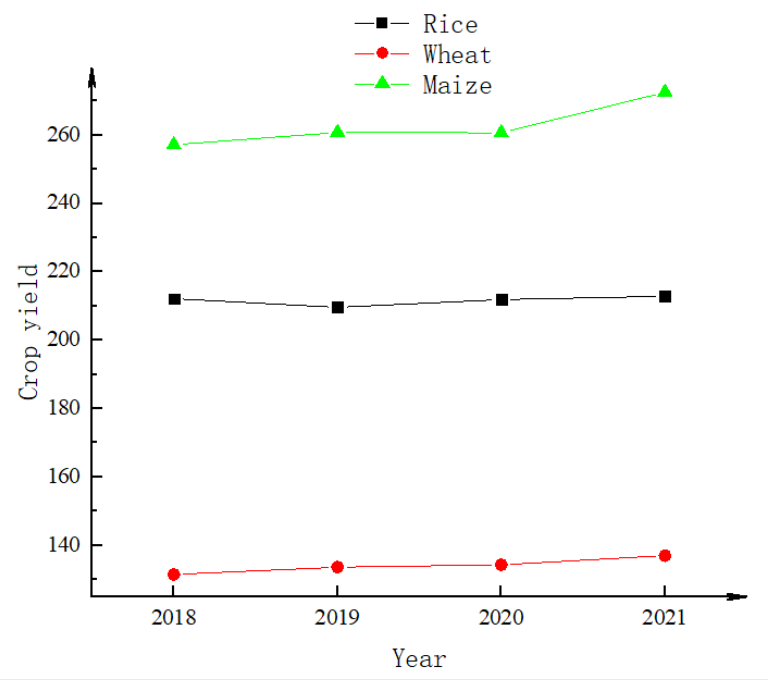
V Key achievements and benefits

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.**

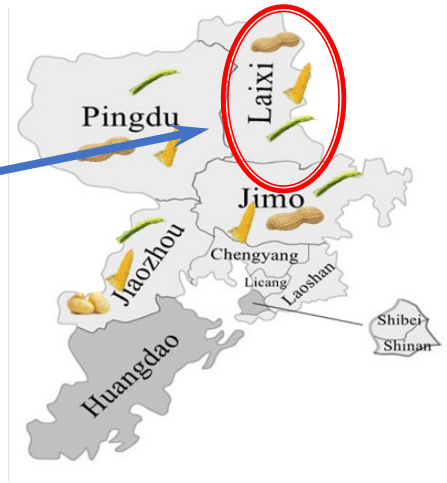
1. Overview of straw management in China

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

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

1. Fertilizer

2. Fodder

Crop straw is collected and processed to make fodder

Integrated Straw Management

3. New energy resources

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

Straw is used as raw materials to cultivate mushroom

4. Base material

Fertilizer

① Returning straw to the field-*Straw cover*

Wheat harvesting and Straw chopping

No tillage seeding of maize

Maize harvesting and Straw chopping

No tillage seeding of wheat

- 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.

Fertilizer

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

Wheat harvesting and Straw chopping

No tillage seeding of maize

Maize harvesting and Straw chopping

Maize straw mixing with soils

Wheat seeding

- 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.

Fertilizer

③ Returning cow manure to the field

Maize ensilage harvesting

Feeding cows

Cow manure collecting and separation

Cow manure fermentation

Returning cow manure to the field

Mixing cow manure with soils

Wheat seeding

- 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

Returning biogas slurry to the field

Mixing biogas slurry with soils

Wheat seeding

- Professional vehicle transportation, no leakage and overflow;
- Biogas slurry should be fully mixed with soils to get good fertilizer effect.

Fodder

Ensilage Maize

Maize seeding

Maize ensilage harvesting

Straw fermentation

Processing fodder

Feeding cows

Milk production

- 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

Processing

Biogas transportation

Usage

- 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.

Base Material
Mushroom Cultivation

Base material preparation

Bagging

Sterilization

Mushroom inoculation

Mushroom cultivation

Harvesting

- 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

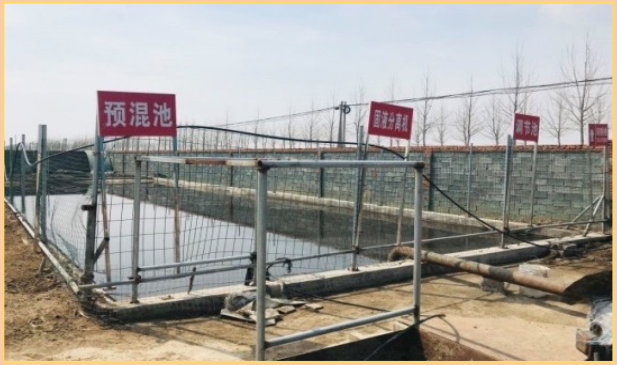
Addition of Dry-wet cow manure separation

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

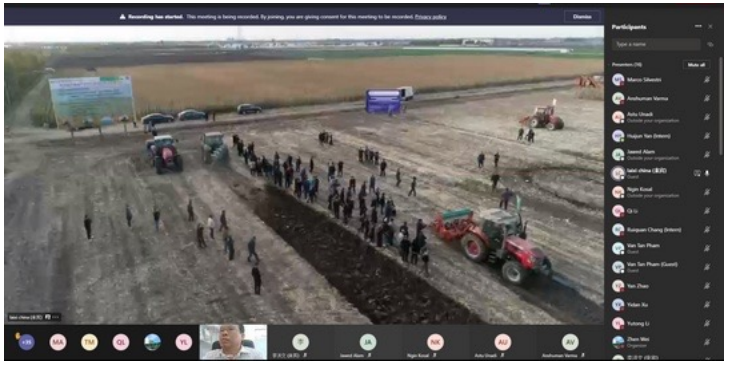
4. Training and awareness generation amongst farmers

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

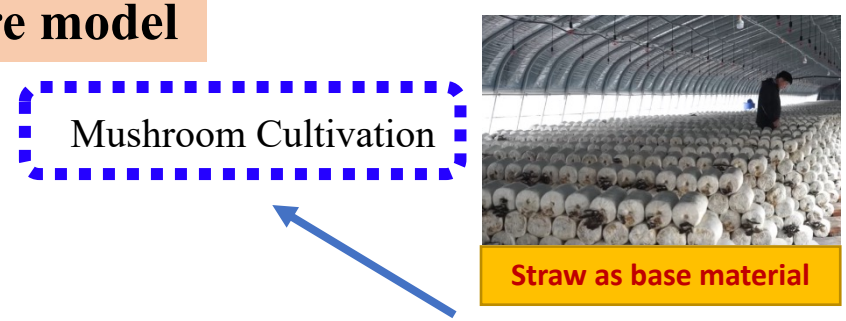
Virtual Workshop and Demonstration



- 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.

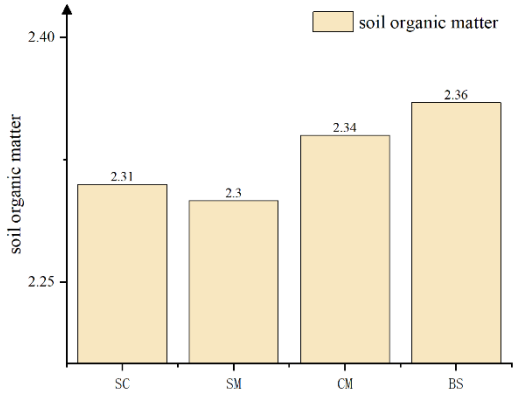
5. Key achievements/benefits

Circular agriculture model



Results and Outcomes

Ecological Indicators



Soil organic matter

345 (tons/year)

Straw burning reduction

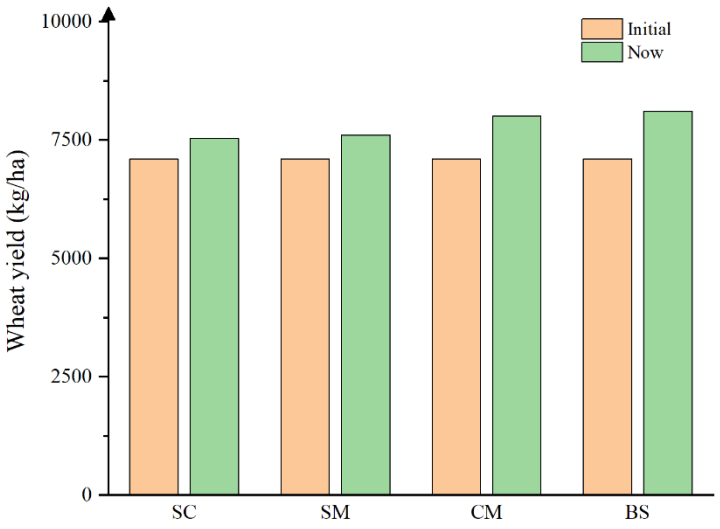
70.25 (tons/ha/year)

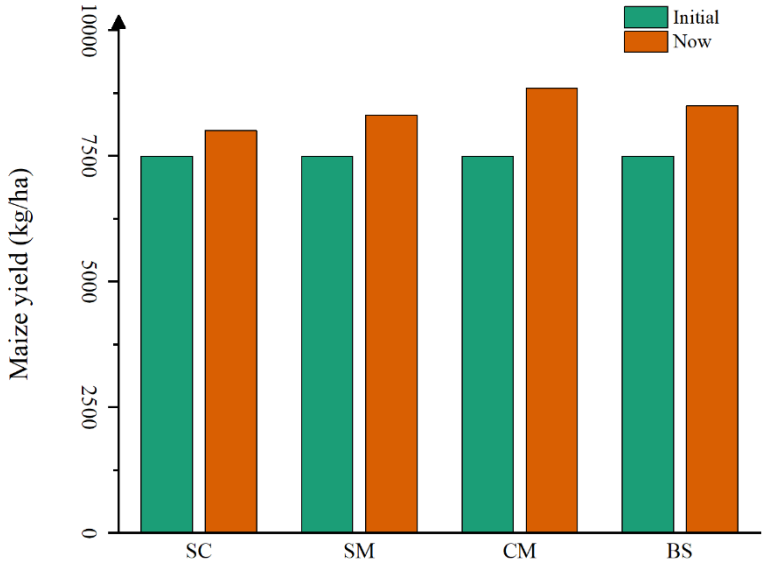
Cow manure returned to the field

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.

Economic Indicators





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. 90,000m^3 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**

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Welcome to visit Laixi, Qingdao demonstration site in China!