

Detailed findings of the East Asia Component of the CSAM Research and workplan of the pilot in China



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CSAM



Acknowledgements

● *Center for Sustainable Agricultural Mechanization (CSAM)*

United Nations Economic and Social Commission for Asia and the Pacific

● *Partners from East Asia Countries*

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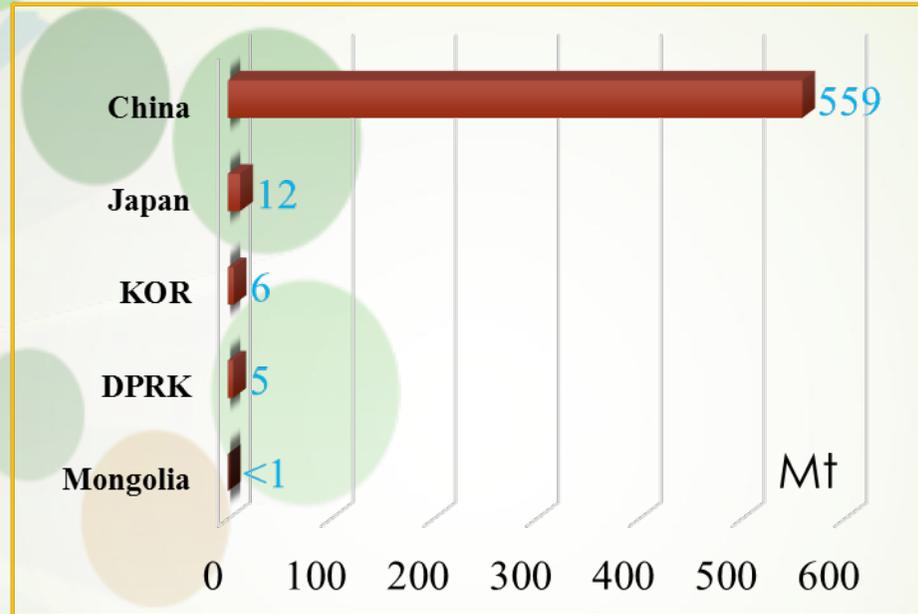
- I. Status of Crop Straw Resources**
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The background features a light green gradient with a sunburst pattern on the left side. The sunburst consists of several rays emanating from a large, semi-transparent white circle. Scattered across the background are various colored circles in shades of blue, green, orange, and yellow, some overlapping the sunburst rays.

Status of Crop Straw Resources in East Asia

1. Cereal production in East-Asia

Cereal production in East-Asia countries

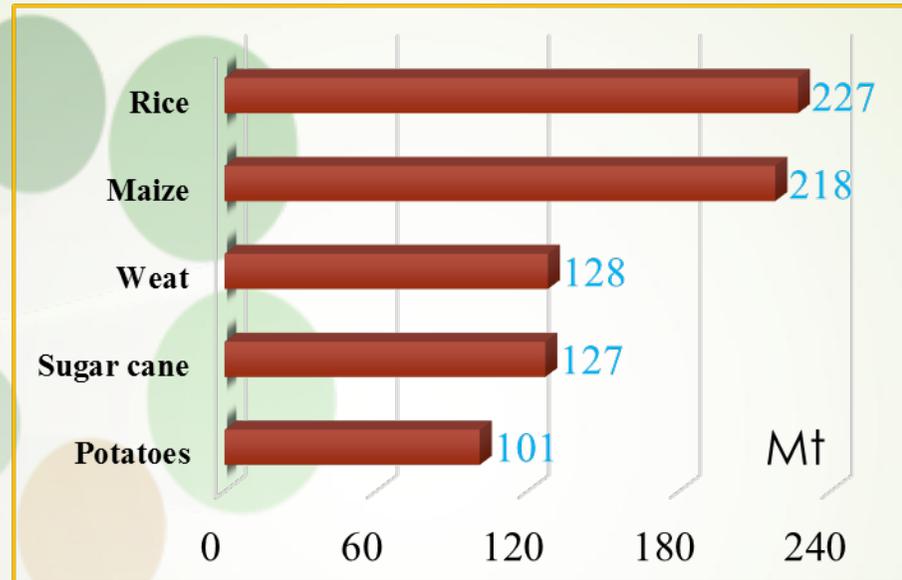


Source : FAOSTATE, 2014

➤ The three most cereal production countries in 2014: **China** (559Mt), **Japan** (12Mt) and **KOR** (6Mt).

2. Main crop production in East-Asia

Production of main crops

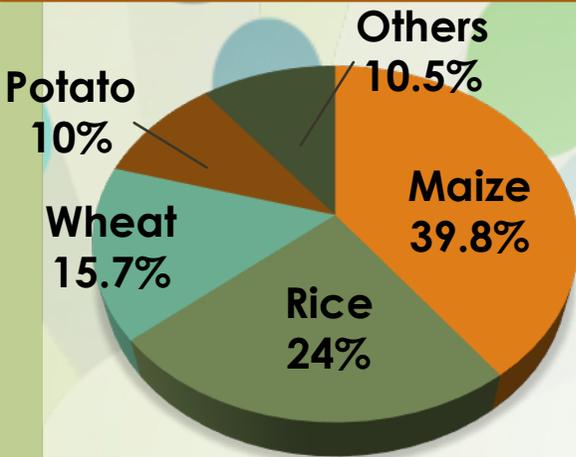


Straw yield was calculated by the ratio of straw-grain: wheat-1.38; maize-2.05; rice-1.28

Source : FAOSTATE, 2014

- The maximum three cereals in 2014: ***Rice, Maize, Wheat;***
- Crop straw yield: ***291, 447, 177Mt***, respectively

3. Crop straw production (Mt) in China



Distribution

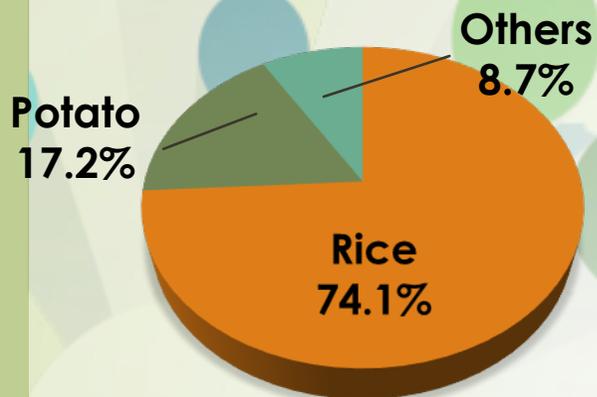
Yangtze valley; South China;
Southwest region; North-China plain;
Northeast region; Yellow River valley

Crop	Straw-grain ratio	2010		2011		2012		2013		2014		<i>Mt</i>
		Grain	Straw									
Rice	1.28	197	252	203	260	206	264	205	262	208	266	
Wheat	1.38	115	159	117	161	121	167	122	168	126	174	
Maize	2.05	178	365	193	396	206	422	219	449	216	443	
Potatoes	1.16	82	95	88	102	93	108	96	111	96	111	

Most crop straw: **maize**

Source: Yuyun Bi etc., 2010; FAOSTATE, 2014

4. Crop straw production (Mt) in Japan



Distribution

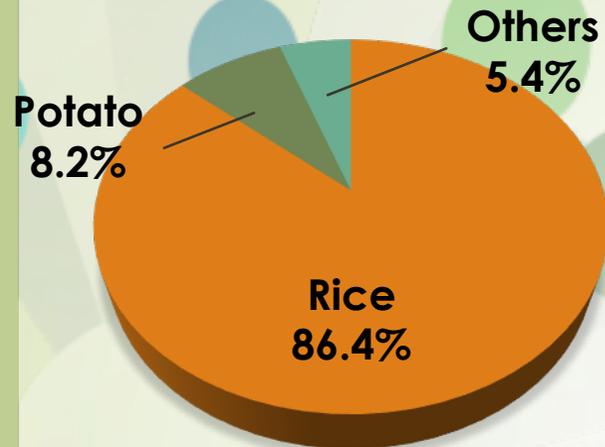
Hokkaido; Niigata; Akita;
Fukuoka; Saga; Kagoshima;
Ibaraki; Chiba; Tochigi

Crop	Straw-grain ratio	2010		2011		2012		2013		2014		<i>Mt</i>
		Grain	Straw									
Rice	1.28	10.6	13.6	10.5	13.4	10.7	13.6	10.8	13.8	10.5	13.5	
Wheat	1.38	0.6	0.8	0.7	1.0	0.8	1.2	0.8	1.1	0.8	1.2	
potatoes	1.16	2.2	2.6	2.4	2.8	2.5	2.9	2.4	2.8	2.5	2.9	

Most crop straw: **rice**

Resource: <http://www.maff.go.jp/e>; FAOSTATE, 2014

5. Crop straw production (Mt) in KOR



Distribution

Jeonnam; Chungnam;
Jeonbuk; Gyeongnam

Crop	Straw-grain ratio	2010		2011		2012		2013		2014		<i>Mt</i>
		Grain	Straw									
Rice	1.28	5.81	7.44	5.62	7.19	5.41	6.92	5.63	7.21	5.64	7.22	
potatoes	1.16	0.62	0.72	0.62	0.72	0.61	0.71	0.73	0.85	0.59	0.68	

Resource: <http://english.mafra.go.kr/main.jsp>; FAOSTATE, 2014

Most crop straw: **rice**

The background features a light green gradient. On the left side, there is a stylized sunburst with a large white circle at its center and several rays extending outwards. Scattered across the background are various colored circles in shades of blue, green, and orange, some of which are semi-transparent and overlap with the sunburst rays.

Status of straw management in East Asia



1.Fertilizer



2.Fodder



3.New energy resources



4.Base material



5.Industry material

Currently, crop straw is mainly used as fertilizer, fodder, new energy resource, base stock and industry material.

1. Current Situation of Straw Management in China

1. Used as fertilizer

Directly returning into field

Straw handling

Covered on soil

Mixed with soil

Buried in soil



Tillage methods

No/minimum tillage

Rotary tillage

Plough

Straw used as fertilizer accounts for **43.2%** of the total straw utilization.

1. Current Situation of Straw Management in China

1. Used as fertilizer

Indirectly returning into field



Carbonized straw
returning



Pre-decomposed
straw returning



Manure
straw returning

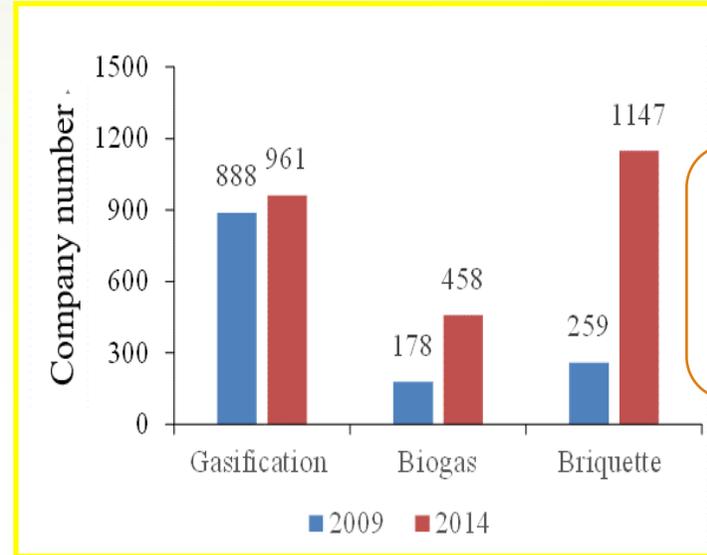
Straw used as fertilizer accounts for **43.2%** of the total straw utilization.

2. Used as fodder



Used as fodder: accounts for **18.8%** of the total utilization of straw.

3. Used as new energy resource



The number of straw gasification fuel, biogas and briquette companies

Used as new energy resource: occupies **11.4%** of total straw usage.

4.Used as base material



Cultivating fungi

5.Used as industry material



Papermaking



3D printing

- Paper
- Knit
- sheet
-

Used as base material: only accounted for a **small fraction** of all the crop straw.

China: the straw pulp can occupy **>30%** of total paper pulp in the country.

2. Current Situation of Straw Management in Japan

1. Used as fertilizer



Straw directly
returning to field



Straw indirectly
returning to field

- Straw used as fertilizer accounts for about **55%** of the total straw utilization.
- For **rice** straw, **75.9%** is mixed with soil and **6.4%** is made into manure.

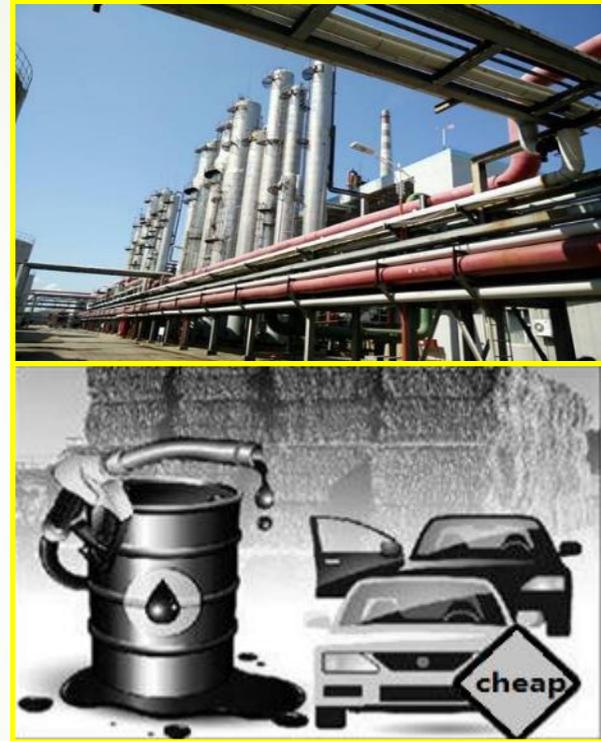
2.Used as fodder



Silage harvester

In Japan, rice straw used as fodder accounts for **10.3%** and most fodder use straw was **coarse fodder**.

3.Used as new energy resource



Using straw to produce ethanol

In Japan, straw is mainly used as **ethanol** for energy.

4.Used as industry material



Straw statue

- In Japan, rice straw for industry utilization accounted for **0.7%**.
- Straw is thatched around wooden frames, and actual number of straw bale buildings in Japan increases every year.

3. Current Situation of Straw Management in Republic of Korea

1. Used as fertilizer



Rice straw returning to field

➤ In Republic of Korea, about **45.7%** of the **rice** straw used as fertilizer.

➤ **24.39 Mt** of rice straw directly returned to field after chopping.

2. Used as fodder



Rice straw used as silage

In Republic of Korea, rice straw used as fodder accounts for **20.8%**, and most fodder use straw was silage.

Beneficial Impacts

Sites	Straw type	Straw management pattern	Benefits
China	Maize	Directly returning to field	Increase yield ; Increase net income
	Wheat	Directly returning to field	Enhance soil fertility ; Saved cost ; Avoided the environment pollution.
Japan	Rice	Directly returning to field	Reduce greenhouse gas emission; Increase soil carbon sequestration.
	Rice	Solidification molding	Prolong the relevant industries chain ; Achieve multiple value-added income.
KOR	Rice	Extract ethanol	Rice straw used for ethanol can reduce the production cost compared to grain.



Workplan for Integrated Straw Management in China

Option 1. Four ways to used as fertilizer

1. Soil covered with straw

Typical technological process includes:



Typical steps:

Chopping



Flail chopper



Reciprocating-cutting chopper

Seeding



No/minimum -till seeder



2.Straw mixed with soil

Typical technological process includes:



Typical steps:

Tillage

Seeding



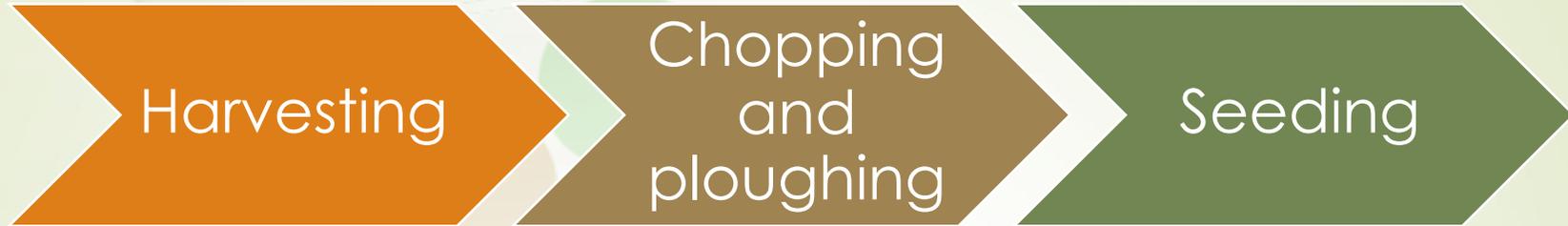
Horizontal roto-tiller

Vertical roto-tiller

Seeder

3.Straw buried with soil

Typical technological process includes:



Typical steps:

Ploughing



Plough



Plough-rotary
combined tiller

Seeding

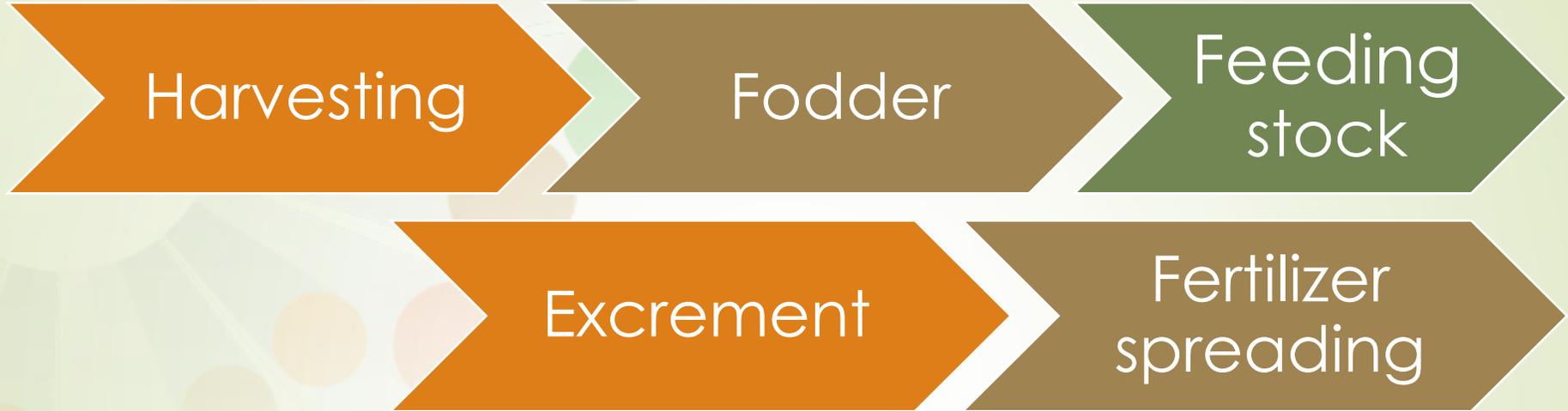


Conventional Seeding



4. Excrement returning

Typical technological process includes:



Typical steps:

Fertilizer spreading



Side spreading



Back spreading

Option 2. Used as fodder

Typical technological process includes:

Collecting
straw

Processing

Feeding



Typical steps:

Harvesting



Self-propelled silage harvester

Processing



Silken machine



Briquetting machine

The background features a light green gradient with a series of semi-transparent, overlapping circles in various colors (blue, green, orange, yellow) and rays emanating from a central point on the left side, creating a sunburst or molecular-like effect.

Research and Demonstration in China

1. Scientific research

a. Effect of the straw management

Management

- ◆ Direct returning
- ◆ Indirect returning

- Straw mulching
- Straw mixing
- Straw burying
- Livestock excrement returning



Effect

- ◆ Soil properties
- ◆ Crop

Physical properties

Moisture content, Soil temperature

Water stable aggregates, Bulk density

Chemical properties

SOM, N, P, K

Crop yield

Emergence rate, plant height, yield

1. Scientific research

b. Improvement of technological process for straw returning

Straw mulching

1. Chop: supported/slide cutting
2. Chopping and spreading straw uniformly
3. Chopping while decomposition

Straw mixing

1. Rotary till-horizontal type
2. Rotary till-vertical type

Straw burying

1. Buried with plough
2. Ditch-buried returning
3. Combine of plough and rotary-till

Livestock excrement returning

Biogas slurry/residue

1. Scientific research

c. Improvement of supporting equipments



Chopper

Straw mulching



Chopper cum spreader



Plow

Tillage



Vertical harrow



No-till seeder

Seeding



Traditional seeder

➤ Combine of agronomy and agricultural equipment

2. Demonstration

Recommended partner



**China Agricultural
University**

Partner advantages

- Rich experience of straw management
- Experts and well trained staffs, master and PhD students
- Relevant instrument and equipment
- Good relationship with local agricultural institutes, farms, etc
-

2. Demonstration

Recommended pilot: **Qingdao**

- ◆ Annual double cropping areas (Wheat-Maize), North-China Plain
- ◆ Huge amounts of straw
- ◆ Urgent for subsequent seeding
- ◆ Good economic condition support

Recommend partner: **Agricultural Machinery Bureau of Qingdao**

- ◆ Local policy support
- ◆ Long-term sites
- ◆ Machines
- ◆ Experiences in straw management (Used as fertilizer, fodder)



Sites that we can select in **Qingdao**



High yield/efficiency straw management

Advantages:

- ◆ Integration of water and fertilizer
- ◆ Area is >100ha
- ◆ Well trained farmers, equipment, agricultural cooperative



Combine farming and animal husbandry

Advantages:

- ◆ More than 200 head of cattle
- ◆ Area is >100ha
- ◆ Well trained farmers, equipment, agricultural cooperative



Long-term conservation agriculture

Advantages:

- ◆ Long-term CA since 2009
- ◆ Area is >100ha
- ◆ Well trained farmers, equipment, agricultural cooperative



Thanks !