Research Status and Development Trend of Rice and Wheat Mechanized Harvesting

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Overview of rice and wheat Production Mechanization in China
Rice planting situation in China

Rice is the **third largest food crop** and about 50% of the world take it as main food.

◆ **In China**
  - rice planting area: **74 million acres**
  - total yield exceeds **200 million tons**

◆ **Three major rice planting areas**
  - The Northeast plain
  - Yangtze river basin
  - Southeast Coast
Wheat planting situation in China

- Wheat is the **second** food crop in China
- planting area: **24 million acres**

- Five major wheat planting areas
  - Huanghai
  - Middle and lower reaches of the Yangtze River
  - Southwest
  - Southeast
  - Northeast
Machinery system of rice and wheat

◆ Rice and wheat machinery system refers to the machines and tools involved in the whole process from ploughing, sowing and harvest.
◆ According to different planting methods, direct seeding machinery or seedling/transplanting machinery is selected.
◆ Harvester is relatively mature technology, including full-feed and semi-feed combine harvesters, as well as segmentation harvesting.
The mechanization level of rice production has reached 74% (2014).
The mechanization level of wheat production has reached 94%
Wheat is the most mechanized crop in China

### Increase of wheat production
**Mechanization level from 2006 to 2014**

<table>
<thead>
<tr>
<th>Year</th>
<th>Tillage (%)</th>
<th>Sowing (%)</th>
<th>Harvesting (%)</th>
<th>Comprehensive (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>80.21</td>
<td>78.98</td>
<td>78.32</td>
<td>79.27</td>
</tr>
<tr>
<td>2014</td>
<td>≈100</td>
<td>86.98</td>
<td>95.08</td>
<td>94.6</td>
</tr>
<tr>
<td>Annual growth rate</td>
<td>2.47</td>
<td>1</td>
<td>2.09</td>
<td>1.92</td>
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</tbody>
</table>
Key technologies and equipment of rice harvest
The main form and performance of harvester

◆ Harvesting method:
Two-stage harvester、combine harvester

◆ Combine harvester:
Head-feeding combine harvester、Full-feeding combine harvester
Two-stage harvesting

Rice windrower

Rice binder

Rice thresher
Head-feeding rice combine harvester

2 rows (0.9m)

4 rows (1.5m)

5 rows (1.8m)

6 rows (2.0m)
Full-feeding rice combine harvester

Crawler rice combine (working width 2.0m-3.2m)

Wheeled rice combine (working with 3.0m-6.2m)
Key technologies and equipment of rice harvest

- Rice and wheat generally use the same combine harvester
- The main working parts of combine harvester including:
  - Header
  - Thresher and separation device
  - Cleaning device
  - Straw chopper device

- Work process
  - video 1: LEXION 600 Crop Flow Gutfluss – 2013
  - advanced technologies
  - video 2: 2016 John Deere S-Series Combines
Advanced technology of header

The function of the header is to cut the crop and transport the crop to the threshing device. It consists of reels, cutters, dividers, conveyors, etc.

Video 3: 600 Series Flex Draper Platform
Advanced technology of header

Header height profile

Adjusted floor length

Hydraulic drive

Slope adjustment

video 4: VARI O 930-500 - 2016  www.nriam.com
Advanced technology of header

Flexible header

video 5: John Deere 600FD HydraFlex™ in Action
Threshing device

The combine threshing unit/system is the most important assembly from the point of view of working processes and the power requirement

video 6: Threshing and Separating
Advanced technology of threshing device

Tangential flow threshing

Multi-cylinder threshing

Video 7: Combine Harvesting Animation (MCS)
Advanced technology of threshing device

Purpose: Improve threshing efficiency

Double roller threshing

Video 8 CTS System
Advanced technology of threshing device

Tangential-longitudinal-axial

- Reduced damage to fragile grains
- Better adaptability of all crop processing
- Low level of grain losses

Video 9: CLAAS TUCANO 500 hibrid cséplőrendszer
Advanced technology of threshing device

Concave adjuster

Video 10: John Deere T670 Combine - Concave Booster Bar
The *cleaning shoe*, necessary to both conventional and rotary combines, is usually composed of a receiving element (preparation floor), a grain pan, a chaffer, a sieve, and a blower system.
Advanced technology of cleaning device

◆ Self-balancing sieve
Advanced technology of cleaning device

◆ 3D cleaning technology
◆ Double-sided vibration mechanism

Video 11: CLAAS 3D Sieve
Advanced technology of cleaning device

◆ 4D cleaning technology

Video 12: CLAAS LEXION 4D-cleaning system
Advanced technology of cleaning device

Screen opening automatic adjustment technology

Video 13: Cleaning Shoe
Video 14: TUCANO cleaning system - 2016
Advanced technology of Scrapping device

Straw chopper device

Video 15: CLAAS LEXION - Straw Management 2014
Video 16: CLAAS LEXION SPECIAL CUT - 2016 – en
Development trend of combine harvester
Development trend of combine harvester

The power of combine harvesters has reached more than 770 horsepower. The main model is about 300 horsepower, with the maximum width of 24 meters, and 9-12 meters generally.

- **Large feed**: John Deere 8kg/s
- **Large cutting width Header**: CASE 25 meters
- **High-efficiency threshing cleaning device**
Large and efficient

CLAAS harvester with a cutting width of 9 meters
Large and efficient
Large and efficient
Large and efficient
(1) Combine Harvester Performance Detection System

The system detects the whole harvesting process including the cutting, feeding, threshing and cleaning Device of the combine harvester.

- cutter vibration frequency;
- reel speed;
- torque and speed of the threshing roller;
- fan speed and vibration frequency of the vibrating screen.
- engine speed and operation speed of the combine harvester.
Intelligent

(2) Combine Harvester Electrical Power-on Self-inspection System

The automatic fault diagnosis of the electrical system can help the combine harvester operator to identify the fault and handle it in time.

(3) Combine Harvester Yield Monitoring System

When the intelligent yield monitoring system is in operation, a group of sensors measure the grain quality or flow per unit time, grain moisture content, machine forward speed, draper platform height, and lifting speed of the grain hoist in real time and transmit digital or analog signals to the control display terminal at the same time to calculate grain yield per unit area.
(4) Measurement of the Entrainment Loss in Combine Harvester

- Traditional detection method: By installing “Force-electricity” sensor at the straw outlet
- Image detection method: The grain images on the platform are collected by the CCD image detection regularly and sent to the processor for analysis to finally obtain the entrainment data.

(5) Combine Harvester Threshing Roller Monitoring System

The effect of threshing has a direct impact on the performance of cleaning and separation devices
Intelligent

(6) Combine Harvester Draper Platform Monitoring System

- Digital camera is used to capture images, identify lodged crop automatically and control the height of the harvester draper platform according to the lodging height;
- The reel speed is controlled automatically.

(7) Measurement of Combine Harvester Cleaning Loss

The amount of grain is detected through the different impact signals of grain and impurities on the sensor.

(8) Combine Harvester Drive System

Combine harvester will develop towards electric and hydraulic drive in the future.
Intelligent

Multiple electronic display screens in the cab to keep track of the machine working and operating status at any time.
Intelligent

Convenient one-lever operating system
Intelligent

One-lever operating system

Management system - Yield map

Automatic navigation system
Intelligent

Threshing roller protection device, overload protection device
Intelligent

Accurate cutting height of John Deere Combine Harvester
Development trend of combine harvester

Equipped with closed, soundproof, shock-absorbing, and environmental parameter adjustable cab, where the driver can know the position, walking route, working state and operation quality of the harvester through the screen in real time, which has greatly improved operator's operating conditions and reduced the degree of fatigue.
Comfortable

John Deere's spacious and comfortable cab
Modular design technology is widely used in modern combine harvesters. Firstly, the chassis is designed as a platform with high universality. The corresponding draper platform is selected according to the characteristics of the harvested crop. The threshing and cleaning devices meet the requirements of different crops generally through adjusting parameters.
CLAAS Harvester implements harvesting of a variety of crops through different draper platforms and detached parts.

- Rape combine harvester
- Rice harvester
- Soybean harvester
- Corn harvester
- Pickup machine
- Grass harvester

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Automatic navigation

- Harvesting according to the optimized path
- Reduce the area of duplicated areas and missing areas
- Improve the quality and efficiency of agricultural machinery in the field
- Reduce the labor intensity of the driver
- Remote control and Agricultural Machine Network
Automatic navigation

Based on Navigation positioning system

➢ Crop growth and yield detection
➢ Multi-machine cooperative navigation technology
➢ Obstacle detection and Active obstacle avoidance
Thank You!