

The Path and Cases on China's Sustainable Agricultural Mechanization

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CSAM



The Path and Cases on China's Sustainable Agricultural Mechanization

- Introduction
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- Path Selection
- Cases



• Introduction

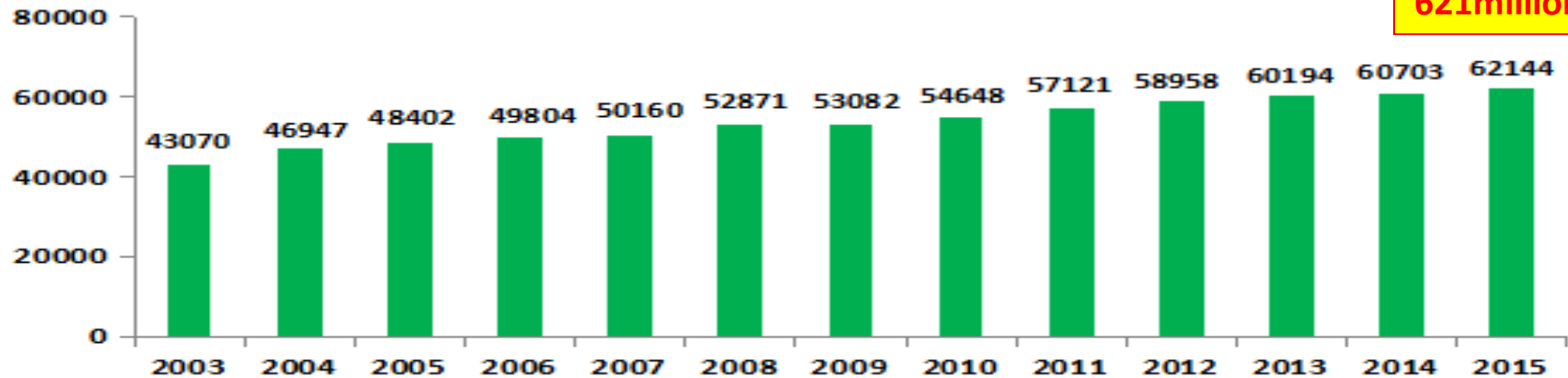
- **Have to face some major issues on China's agriculture**
 - ✓ First, the task to ensure food safety and livestock products effective supply is still arduous, it's urgently needed to change agriculture production way.
 - ✓ Second, resource constraints and the ecological environment pressure on the agricultural development appears to be growing, it's urgently needed to promote resource-saving, environmentally friendly and sustainable development.
 - ✓ Third, more and more environmental disasters continually happened, it's urgently needed to popularize agricultural energy conservation and emissions reduction technology.



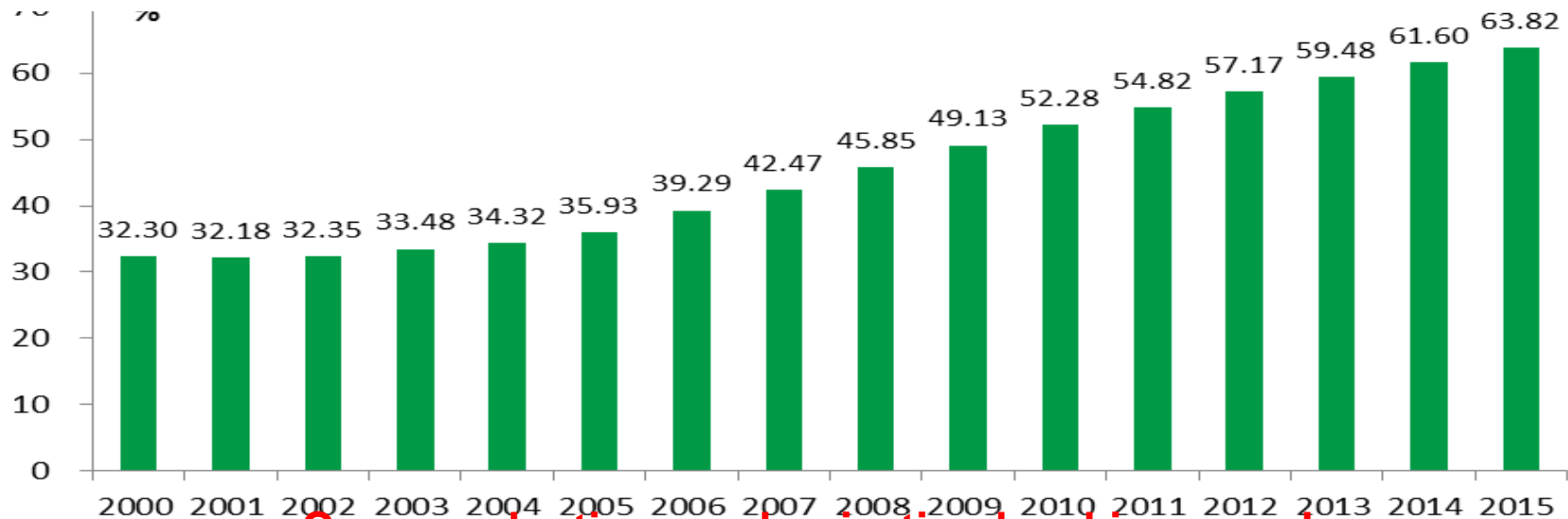
• Introduction

China grain yield increased continuously for 12 years

Grain Yield of China (10,000 tons)



Grain Yield of China (10,000 tons)



Crop production mechanization level improved

The 4th Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific

• Introduction

- But it was paid a huge price to achieve grain output increased continuously for 12 years in China
- Resources and environment cost too much and elements configuration is very fragile.
- ✓ In the area of water usage: the effective utilization coefficient of irrigation water in China is only 0.52, it is 0.2 percentage points lower than the world advanced level and the actual water consumption of major grain-producing areas is generally more than water resources sustainable use.



• Introduction

- ✓ **In the area of chemical fertilizer usage:** China's grain output accounts for **16%** of the world, however, fertilizer consumption accounts for **31%** of the world and use intensity is **2.7 times** the world's average. The pollution cost resulted by excessive use of chemical fertilizers exceed the benefits of increasing production.
- ✓ **In the area of pesticide usage:** Annual pesticide consumption is about **1.8 million tons** but utilization rate is less than **30%**. Pesticide usage per unit area is **2.5 times** the world average.
- ✓ **In the area of plastic film usage:** Plastic film usage on cropfields is about **2.4 million tons** per year but can be recycled less than **1.4 million tons**.



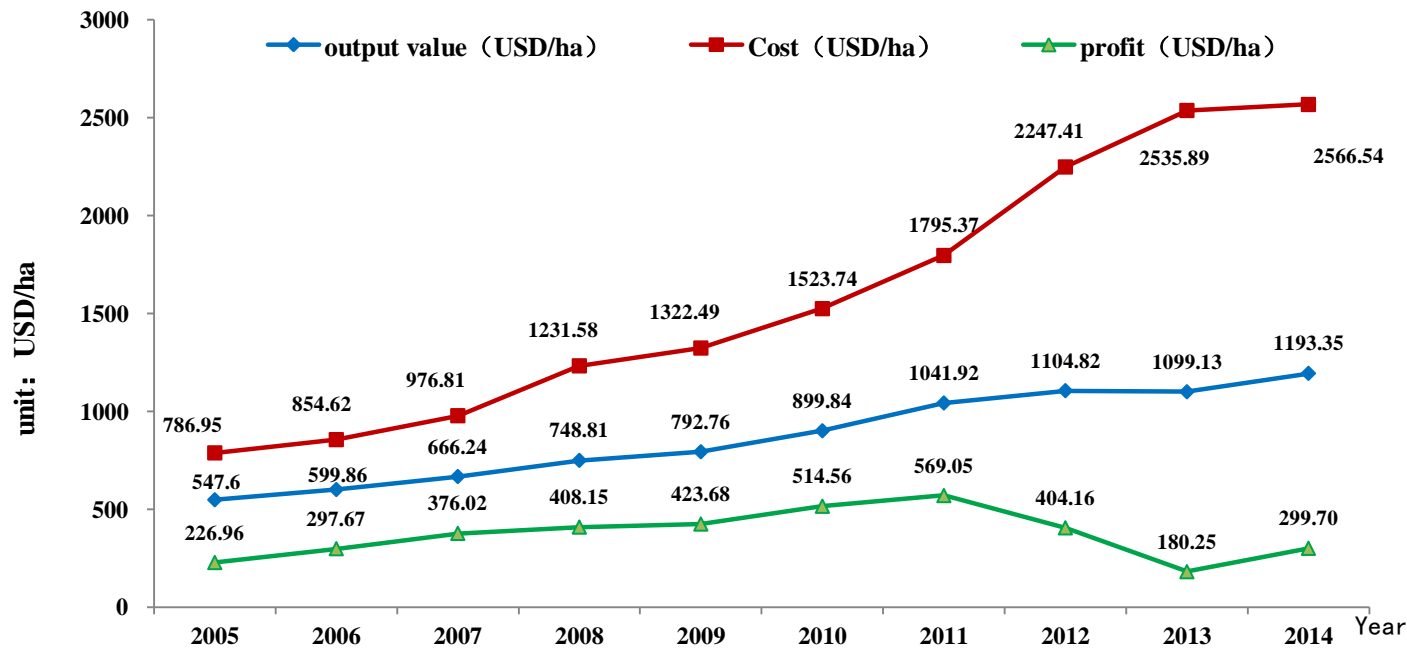
• Introduction

- **Agricultural production costs rose and comparative efficiency decreased.**
- ✓ Factors of production, such as the price of agricultural production, land rent and labor cost are rising.
- ✓ Planting benefit showed a downward trend. The pure income of planting a hectare of food is only US\$300.



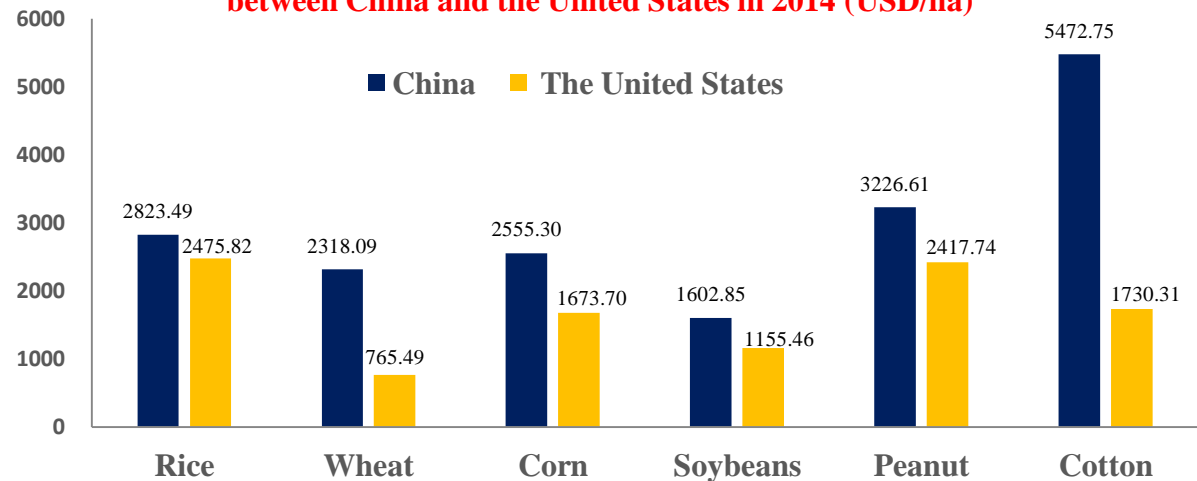
• Introduction

- **Agricultural production costs rose and comparative efficiency decreased.**
- ✓ It showed the output value, cost and profit per hectare of wheat/rice/corn
- ✓ Food production efficiency decreased year after year, and the enthusiasm of farmers has been greatly influenced.

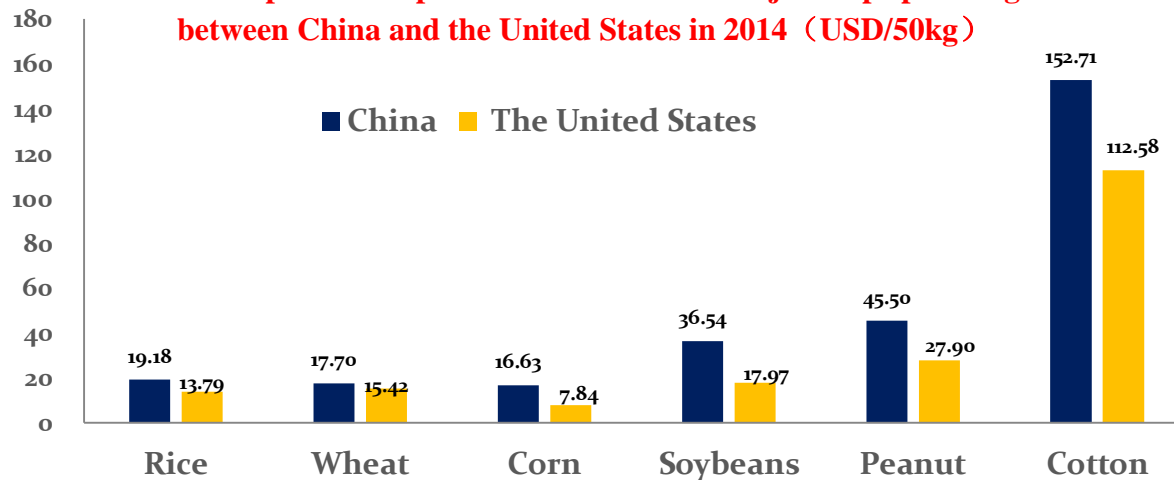


China's production costs of wheat and cotton are more than three times that of the United States.

The comparison of production costs of six major crops per hectare between China and the United States in 2014 (USD/ha)



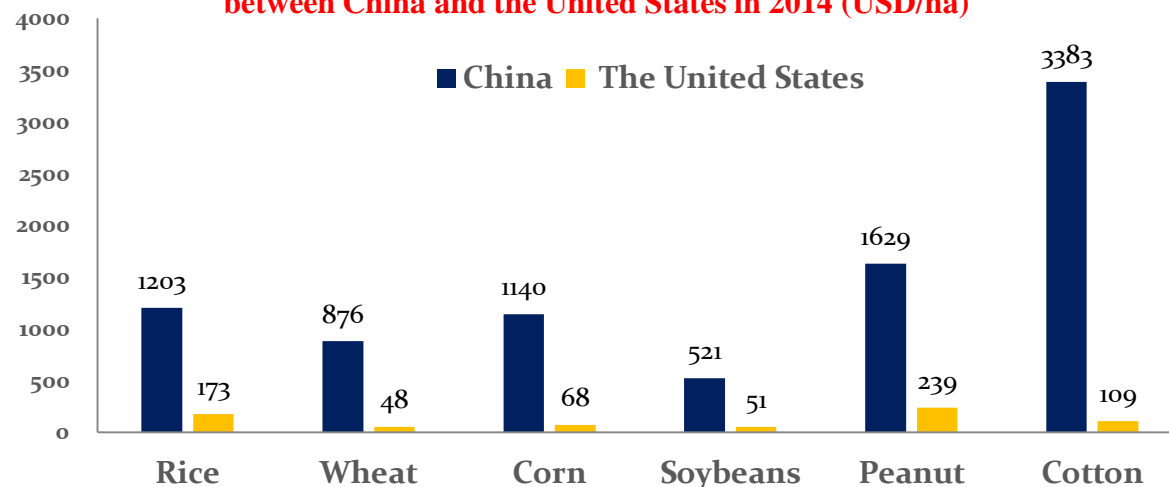
The comparison of production costs of six major crops per 50kg between China and the United States in 2014 (USD/50kg)



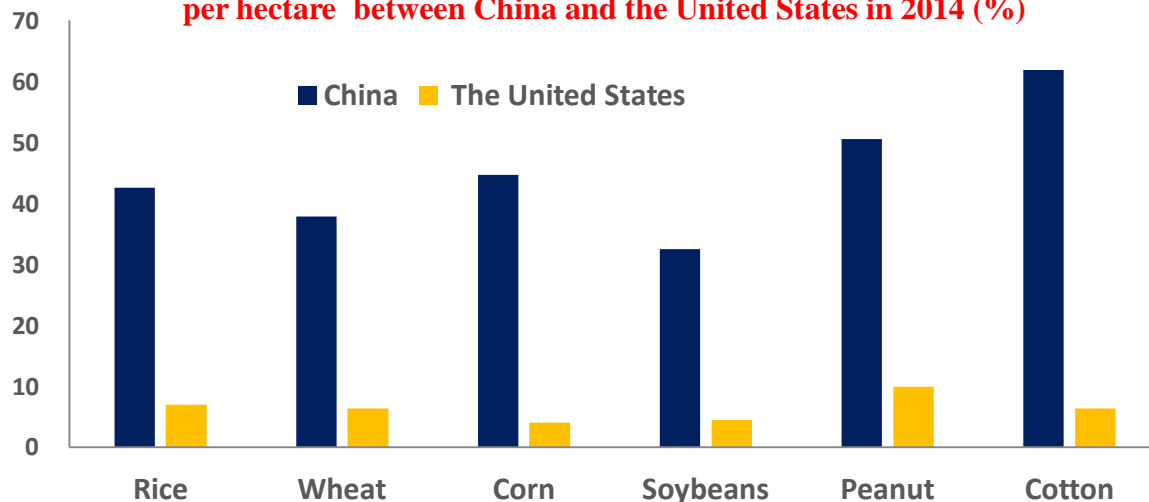
China's production costs of corn and soybean are more than two times that of the United States.

China's labor costs of rice and peanuts are 7 times that of the United States, China's labor cost of soybean is 10 times that of the United States, and China's labor costs of corn and wheat are respectively 17 and 18 times that of the United States.

The comparison of labor cost of six major crops per hectare between China and the United States in 2014 (USD/ha)



The comparison of occupation ratio of labor cost of six major crops per hectare between China and the United States in 2014 (%)



American labor costs accounting for total cost of six major crops are all below 10%, but China's labor costs accounting for total cost of six major crops are all above 40% except for wheat and soybean.

• Introduction

➤ Rural labor force are transferring to non-agricultural industries and urban rapidly

- ✓ It presents the aging trend of agricultural labor force
- ✓ The rural migrant labor to business has more than 263 million, 60% of them are under 40 years old.
- ✓ Nearly one-third of agricultural labor force are more than 50 years old.
- ✓ It's more urgent to use machinery instead of labor in agricultural production.

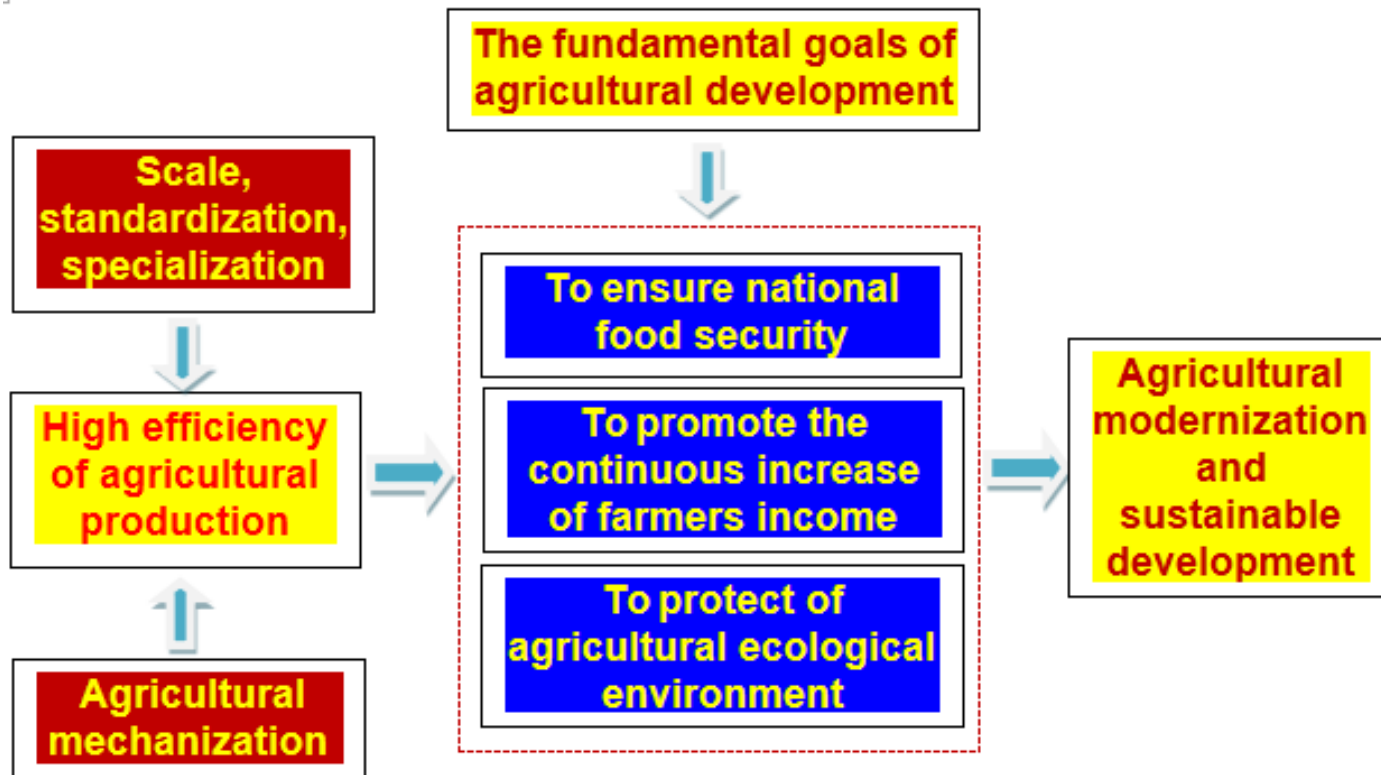


• Introduction

- China's grain production is basically the old path of input elements.
- The agricultural ecological environment is facing unprecedented pressure and challenge.
- So we must take the path of the sustainable development of resource saving and environmental friendly.



• Trends



• Trends

- There were two viewpoints about American productivity growth in grain production
 - The role of AM was **about 60%** of labor productivity growth in wheat production in 1840-1860 and 1900-1910 (by W.N. Parker & J.L.V. Colin)
 - The role of AM was **about 70%** of agricultural productivity growth in the United States in 1880-1960 (by Vernon Ruttan & Hayami Yujiro)



• Trends

- ✓ American engineering and technology field evaluated that agricultural mechanization was **one of the 20 engineering technologies** with the huge role to promote the progress of human society in the twentieth Century, and **ranked 7th**.
- ✓ This evaluation was based on agricultural machinery were widely used in agricultural production in 100 years and had triggered fundamental changes to **the agricultural production mode**. Agricultural mechanization has greatly improved **the agricultural labor productivity** to ensure the world's agricultural development and food security strongly.



• Trends

➤ In the transition period from traditional agriculture to modern agriculture

- AM is the **key factor** influencing the agricultural international competitiveness.
- The level of agricultural mechanization is **the core to form agricultural international competitiveness**, which determines the strength or weakness of agricultural international competitiveness.

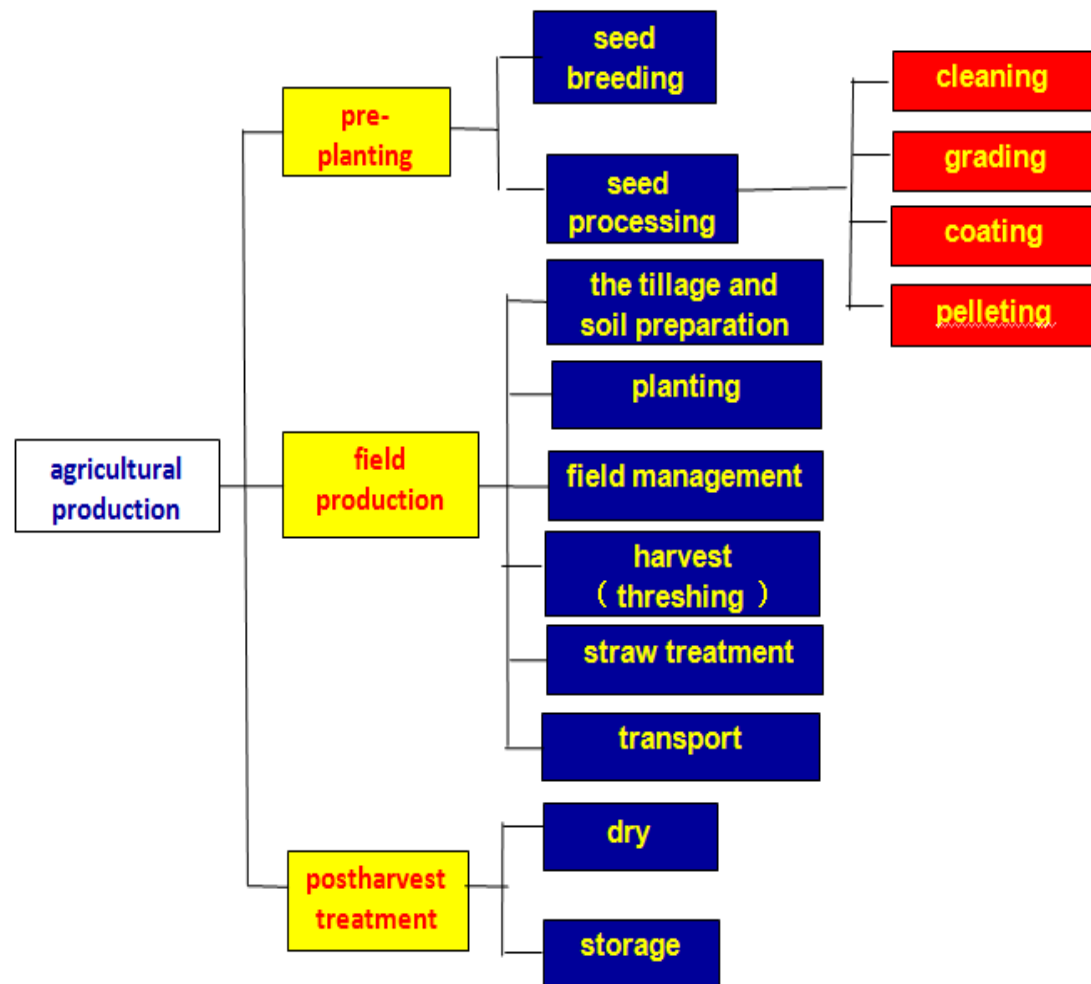
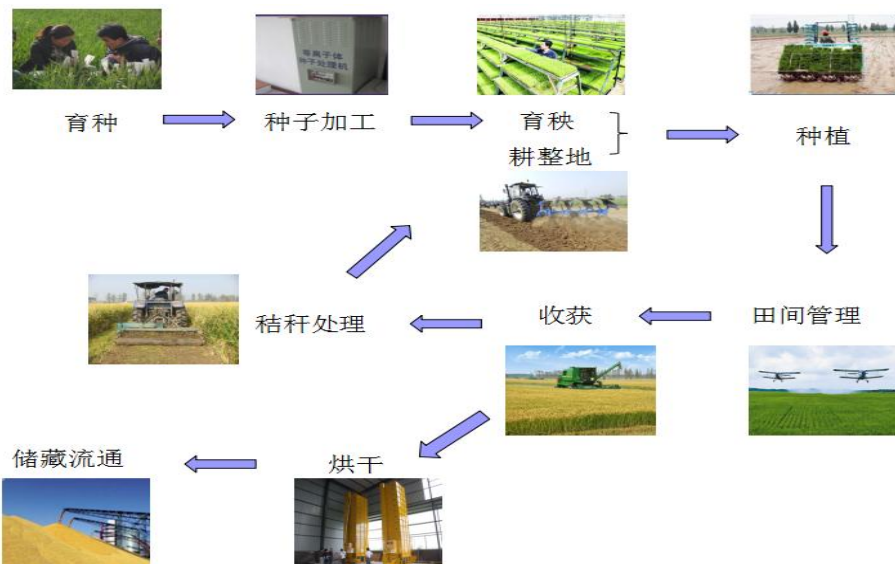
(in my Ph.D paper)



• Trends

✓ The government leads AM to

- fully mechanized agricultural production
(To explore fully mechanized agricultural production patterns based on the agricultural industrial and cooperation organization)



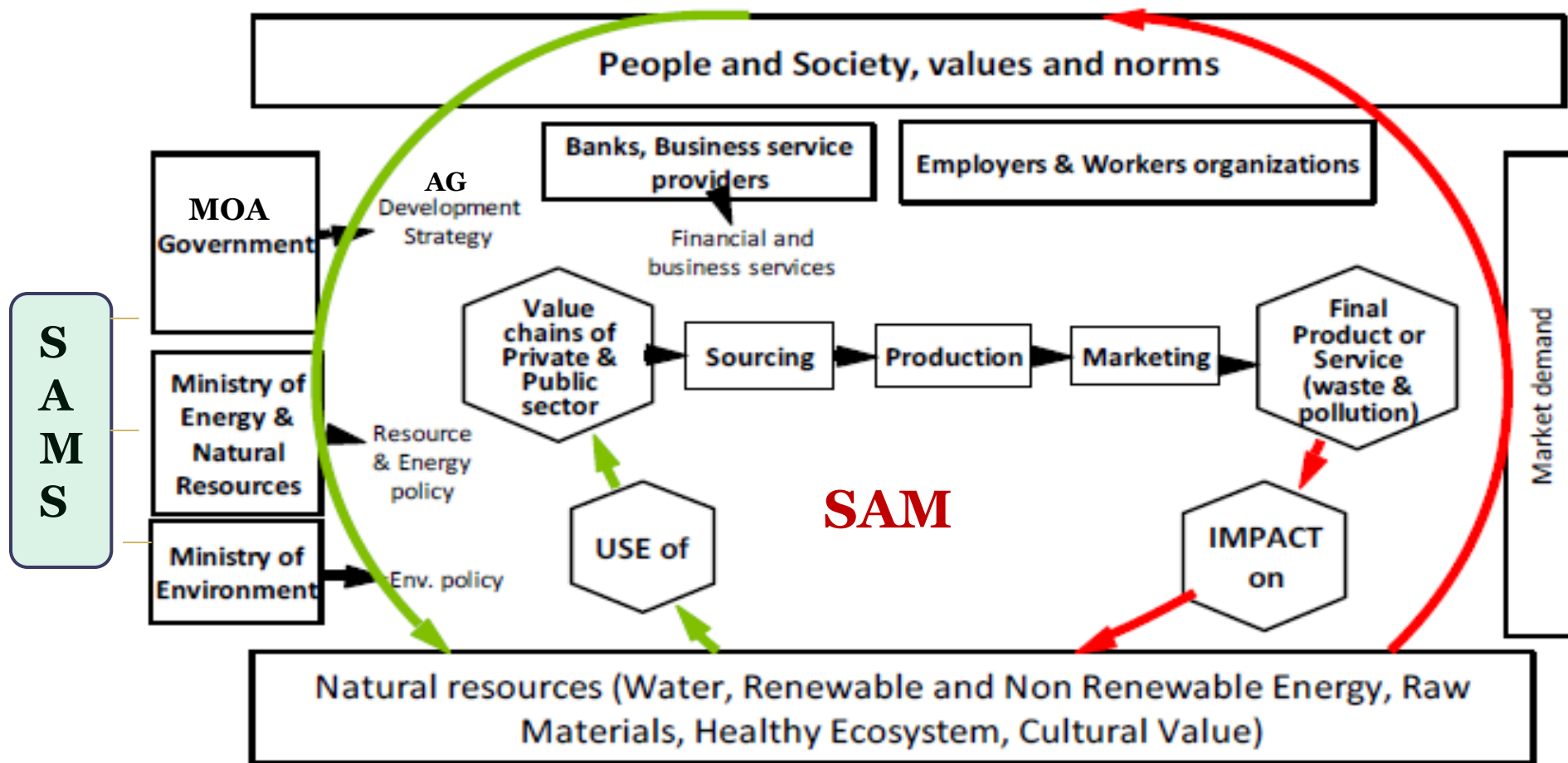
• Trends

- ✓ **The government leads AM to**
 - **Comprehensive** (include all areas of agriculture and all parts of China)
 - **High-quality** (include development quality and quality products)
 - **High-efficiency** (production effectiveness, increase energy efficiency and ecological environment)
- ✓ **The road of sustainable agricultural mechanization.**



• Path Selection

SAM elements and environment



Source – Adapted from Donor Committee on Enterprise Development , FAO, 2012

• Path Selection

- **Sustainable mechanization production technology and equipment**
 - ✓ Conservation tillage technology and machinery
 - ✓ Agricultural machinery subsoiling technology and implements
 - ✓ Efficient plant protection technology and equipment
 - ✓ Mechanized technology and equipment of straw returning to field
 - ✓ Postharvest treatment and processing mechanized technology and equipment
 - ✓ GIS, GPS are used in agricultural machinery and agricultural production to improve the precision and efficiency of production and management.
 - ✓



• Path Selection

➤ Focus on as follows

- ✓ **Control the total amount of agricultural water:** The utilization coefficient of agricultural water use should be improved from 0.52 to 0.55 by engineering measures and water saving mechanized technical measures.
- ✓ **Reduce the total amount of chemical fertilizer and pesticide:** The utilizable ratio of chemical fertilizer and pesticide are improved by mechanized precision fertilization and applying pesticide.
- ✓ **Treatment of livestock and poultry pollution, plastic film recycling and straw treatment:** Resource utilization of agricultural wastes should be realized by mechanized technologies and engineering measures.



• Path Selection

- **Organization scale and operation scale continues to expand**
- ✓ **Family farm:** There are close to 900 thousand family farms in China and an average family farm has 13 hectares of arable land.
- ✓ **Agricultural machinery cooperatives:** There are 57 thousand agricultural machinery cooperatives in China. A large-scale cooperatives usually has 3-4 hundred hectares of arable land and provides social services.
- ✓ **Agricultural enterprise:** Some agricultural enterprises provide postharvest treatment and processing to guarantee the quality and increase the added value of agricultural products.



• Path Selection

➤ Sustainability of policies and measures

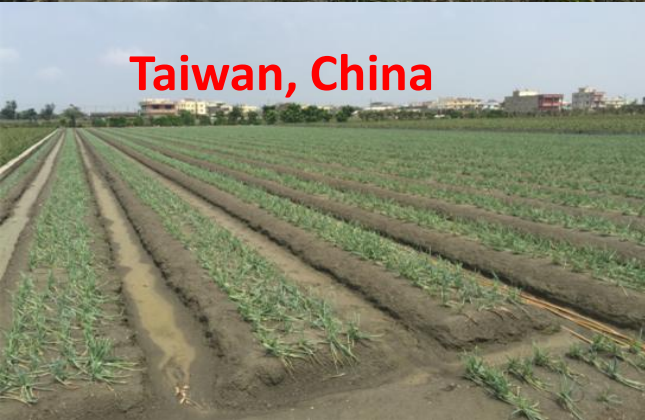
- ✓ The combination of market mechanism and government support.
- ✓ Subsidy policy for the purchase and scrap update of agricultural machinery.
- ✓ Subsidy for agricultural machinery subsoiling
- ✓ The promotion and demonstration of the technology and equipment of sustainable mechanization.



• Case-1

➤ The farmland scale is the foundation of agri. mech.

✓ China's government is implementing *The High Standard Farmland Construction Planning* now.



• Case-1

➤ Expand farmland scale to improve use efficiency of agricultural machinery power

- ✓ The agricultural machinery power is **0.75-1.05kW/ha** in USA and UK, and about **4.95kW/ha** in South Korea, but about 5.7kW/ha with 64% of crop production mechanization level in China.

UK



**Hampdem Bottom Farm(750ha):
0.9kW/ha**



**UPTON ESTATE(800ha):
0.75kW/ha**

USA



**Lyle Greenfield Farm(1300ha):
1.05kW/ha**



**Taylor Farm(800ha):
0.9kW/ha**

• Case-2

➤ Haibin Agricultural Machinery Cooperative in Jiangsu Province

- ✓ arable area: 300ha
- ✓ agricultural machinery operation service: 600ha
- ✓ **Fully mechanized production**
- ✓ **To use unmanned aircraft for field plant protection operation to improve the production effectively.**
- It needed 20 people to work a day to complete 65 hectares of paddy field plant protection operation in the past.
- But it only needs 2 people to work a day now.
- To reduce pesticide application rate 10%.
- To save cost more than 20%.



• Case-2

➤ Haibin Agricultural Machinery Cooperative in Jiangsu Province

- ✓ To Realize the paddy field harvest - drying - rice processing - finished bagging mechanization to reduce the loss in the production process and increase the additional value of products more than 45%.
- ✓ To install the GPS in the tractor and harvester to realize real time information collection and data statistics for field operation and to increase work efficiency more than 5%, and save the cooperative management costs 40%.



• Case-3

- The fertilizer transplanter reduces the amount of labor and fertilizer and improve the efficiency of fertilizer.
- ✓ It's basic principle is to apply granular compound fertilizer in deep soil at the same time of planting.
- ✓ The field trial result in Jiangsu province was that it could reduce the amount of fertilizer **30%**, increase rice production by **about 6%** and income **RMB1600/ha**.
- ✓ It also reduced pollution of fertilizer for field water and soil.



• Case-4

➤ The whole monitoring management for agri. mechanization based on the Internet of Things got started in China.



China's young farmers



China's young farmers



China's young farmers at a meeting



• Conclusions

- ✓ AM can improve agricultural labor productivity and the farmland ecological environment.
- ✓ Governments should increase the support for AM in China and other developing countries.
- ✓ Choose the suitable development model in different regions and countries.
- ✓ Governments should support for the application and popularization of AM technology of energy saving and environmental protection.
- ✓ Enlarge the scale of land management, support the development of agricultural cooperatives and family farms.
- ✓ Examine the costs and benefits of mechanized system





Imagine a World with No Hunger, an Endless
Supply of Energy, and a Healthy Environment

Thank You

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