

## **A study and exploration of grain storage modes of Chinese farmers**

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### **Abstract**

This project focuses on the current status of farm storage of grain in China and the technical development of storage equipment and storage methods, by analyzing the data in average quantities and cycle quantity fluctuations of stored grain of Chinese farmers and studying the relationship between the stored grain quantities and the major factors affecting it. The outcome of modes of farm storage of grain in China has been demonstrated and the storage quantity of grain and the storage modes in China for the next few years have been predicted; both the adequate grain capacity for storage equipment and the technical modes of storage for farmers have been predicted. Furthermore, the trend in technical development of farm storage of grain in China has been proposed.

Keywords: farm storage, mode

### **1. Grain storage status and feature for Chinese farmers**

There are 250 billion kg of grain stored in Chinese rural households each year, which account for 50% of the total output of the national grain. According to the survey data from the State Administration of Grain, the total grain output in 2009 was 533.5 billion kg, the household grain storage stock at the end of the year was 267.8 billion kg, accounting for 50.5% of the total grain output (National Development and Reform Commission, State Administration of Grain, 2011). There are 0.25 billion farmers in the country, and 0.21 billion farmers do farm work and store the grain, accounting for 85%, and the average household storage grain is about 1275 kg. The farm storage equipment is crude, the technology level is low, and a considerable amount of grain is lost due to pest damage, especially in the main producing areas. According to the sample survey from the State Administration of Grain, the average grain storage loss rate for the national farmers is about 8%, there are 30 billion jin of grains lost each year which equals to the output in over 40 million acres of fertile land. Among the main stored grains, the corn is the highest at about 11%; the average loss rate for the paddy is about 6.5%, and that for wheat is about 4.7%.

### **2. Research on storage technology**

Four new grain storages suitable for different regions and grain categories were developed, related technical standards were formulated, and the system was through implementing the “grain high-yield technology project” beginning in 2004.

#### *2.1. Color plate combined silo*

The color plate combined silo is a household grain storage suitable to store paddy, wheat and corn and other grains. The height of the color plate is 0.4 m, the diameter is generally 1.2 m, the height is 1.36 m, the capacity is 1.5 cubic meters, and it can load about 1 ton of grains. The silo consists of three silo circles with each circle of 10 ripples. In order to facilitate the release of grain, there is a grain-releasing outlet at the ground. The silo has the following

features: the material does not easily rust, the life is long; it is rat-proof and damp-proof, the stored grain can be kept from molding. Also, it economical, attractive, durable, and space-saving; folds when not in use.

### 2.2. Steel frame rectangular silo

The silo is suitable to store high-moisture corn in northeast China. The outward silo is supported by a steel frame, the length is 4 m, the width is 1.5 m, the height is 2 m, and the capacity is 12 cubic meters, which can effectively store high-moisture corn with the moisture content below 25%. In winter and spring, it can reduce moisture content with natural ventilation, the corn quality is higher than corn dried mechanically, and it is also keeps corn from damage by pests and mold. The steel frame rectangular silo is, attractive and durable.

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**Figure 1** Color plate combined silo. **Figure 2** Steel frame rectangular silo.

### 2.3. Wooden frame metal net silo

This is a wooden frame rectangular silo with an inner wall of steel wire gauze. The length is 2.2 m, the width is 0.7 m, the height is 1.6 m, and the capacity is 1.5 cubic meters. The silo timber and local material. It is suitable for the farmers in Xinjiang, China to store wheat. The structure has similar features to those above.

### 2.4. Farmer small steel plate silo

The silo is for large scale storage in North China and the Yangtze River plain. The diameter is about 4.6 m, the height is 9.6 m, the capacity is 90 cubic meters, and it can store 50 tons of grain. It can be equipped with automatic systems to measure temperature and aerate the grain. It is suitable for paddy and wheat.



**Figure 3** Wooden frame metal net silo. **Figure 4** Farmer small steel plate silo.

### 3. Research on Chinese farmers' grain storage technology mode

Poor management is the main reason for the severe loss of stored grain in China. After conducting in-depth research of stored wheat, corn and rice in different regions in three regions, eight sets of household grain storage technology were optimized and integrated. After the application and promotion to farmers, grain loss was reduced to about 1.02%.

#### 3.1. Wheat storage process mode

The climate of the North China plain region is high temperature, dry climate and concentrated rain in summer, with comparatively dry air and relatively low humidity in the hot season of wheat harvest. Three different storage systems were researched: conventional storage, heat sealed storage and natural hypoxia storage mode (Ruolan et al., 2006).

#### 3.2. Corn storage process mode

Climate in the northeast plain is characterized by long winters with cold temperatures, and high humidity. Because corn harvest can result in huge yields, much of the corn can be stored outdoors where it is subject to damage. Three kinds of systems were researched for corn: ear storage, grain storage, dried-corn storage (Gang et al., 2006).

#### 3.3. Paddy storage process mode

The Yangtze River plain has high temperature and high humidity during the summer. Two storage systems were researched for paddy: safe-moisture paddy storage and high-moisture paddy cooling storage.

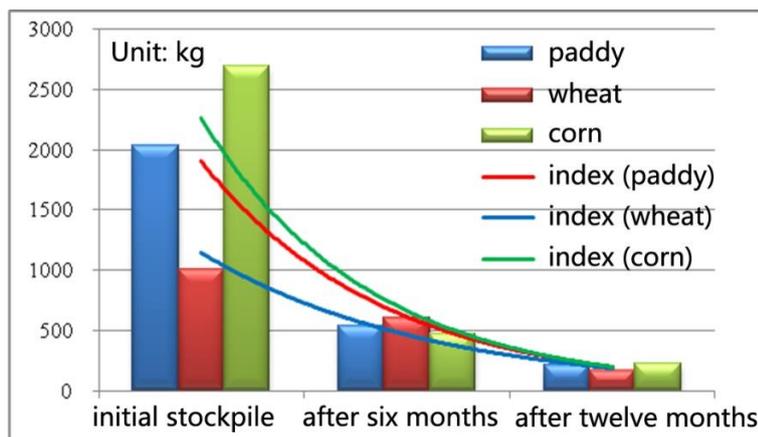
### 4. Research on farmers' grain storage quantity and main influencing factors

#### 4.1. Average household grain storage quantity

China's average household grain storage quantity fluctuates from 1400 kg to 1000kg, at the end of the year, the average household balanced quantity in the main production area of grain is higher than that in the non-main production area. The average household grain storage quantity is closely related with the grain market price, labor costs and family ration demand.

#### 4.2. Average grain storage quantity change

According to the sampling survey data from 6200 households', part of a survey conducted by the Sinograin Chengdu Grain Storage Research Institute, the overall storage fluctuation for various grains within one year after the harvest is larger, and it shows a downward trend. Within six months after harvest, the downward trend of grain storage is significant, and that in the following six months this trend levels off.



**Figure 5** Storage quantity and change trend at each period for various grains in the country.

There is a huge difference in grain storage for southern and northern farmers in China. The multi-season planting is popular in the south and two harvests can be produced, so, the farmer only needs to reserve the grain for six months, while the northern farmer needs to reserve the grain for 9-12 months.

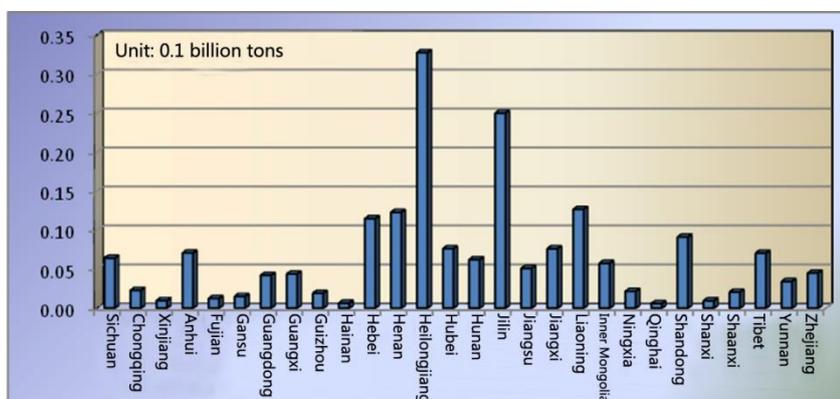
#### 4.3. Research on farmers' grain storage model

According to the influencing variables of rural household's net income at per capita (I), peasant family resident population (H) and grain yield (P) on Chinese farmer's stored grain (Y), the Chinese farmer's grain storage model is researched through the regression result:

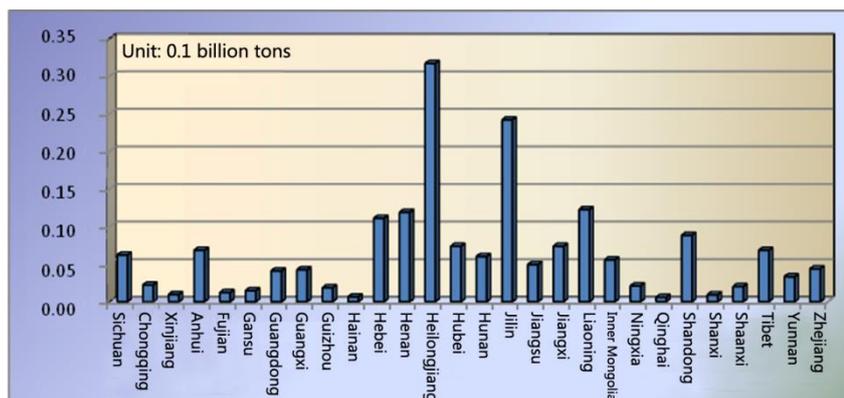
$$Y = 8488.032 + 0.127P - 1649.043H - 0.273I$$

Grain output is positively correlated with the household grain storage quantity; the family resident population, rural household's net income at per capita are negatively correlated with the farmer's grain storage quantity. The order for the factors influencing the farmer's grain storage is household net income at per capita (I), peasant family resident population (H) and grain output (P).

Through the output prediction, household number prediction (rural household resident population prediction, rural migrant employment prediction and rural population prediction), farmer grain balance grain prediction at the end of year, it is expected that the national household grain storage quantity in China in 2015 is 370 billion jin, and in 2020 will be 360 billion jin.



**Figure 6** Household grain storage predictions in each province (region) in China in 2015.



**Figure 7** Household grain storage predictions in each province (region) in China in 2020

## 5. Education

At the end of 2013, the new grain storage equipment was deployed in 25 provinces (regions), thus reducing the farmer grain storage loss by over 9 billion jin, and realizing a direct economic benefit of over 10 billion Yuan (State Administration of Grain. 2013). The project outcome changed the way grains were stored, reduced household grain storage loss, increased farmer income, and promoted grain security.

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