中国小农户主要粮食储藏方法

Smallholder Grain Storage for Main Grains in China

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Sinograin Chengdu Storage Research Institute

Cloud School

Sharing for Learning

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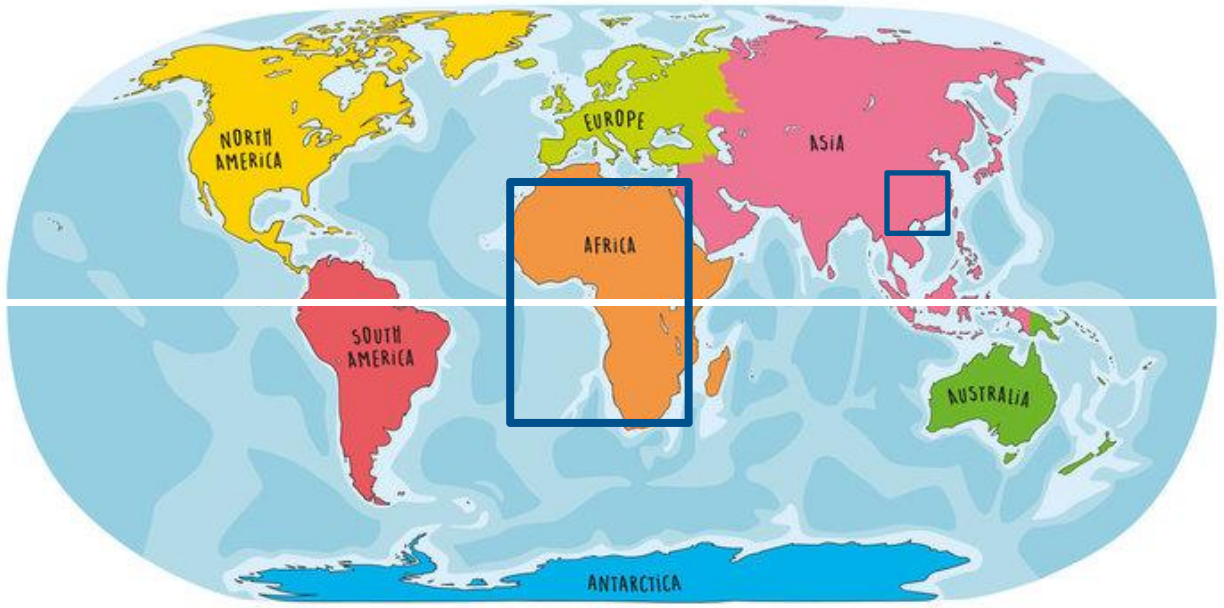
Main Stored Grains

储存的粮食种类



非洲的气侯与中国南部的气候相似，在中国南部种植的谷物主要是稻谷、也有一部分小麦和玉米
The climate in African countries is similar to that of southern China. In southern China, the primary grain cultivation focuses on paddy, while wheat and maize are also planted in some areas.

02

Characteristics of Grain Storage

粮食储存特性

稻谷 Paddy

➢ 易发芽 Easy to sprout

水分约25%，且在10℃以上温度即可发芽。

Sprouting can occur when the moisture is around 25% and the temperatures are above 10°C

➢ 易沤黄与霉变 Easy to Yellowing and moldy

水分超过18%时，20~30℃，堆放一周可产生10%黄粒米。

When moisture exceeds 18% and the temperature is between 20–30°C, about 10% of the grains can turn yellow after one week of piling.

- **不耐高温与易陈化 Not resistant to high temperatures and prone to aging**

暴晒或骤冷易引发米粒“爆腰”

Exposure to strong sunlight or sudden cooling can easily cause the rice grains to crack ("exploded belly").

- **易虫害侵染 Prone to pest infestation**

玉米象、谷蠹等害虫在春夏季活跃。

Pests like rice weevils and grain borers are active during the spring and summer seasons.

水分在13.5%以下，以延长贮藏稳定性
Moisture content should be kept below 13.5% to prolong storage stability.

小麦 Wheat

- **后熟期长：收获后约两个月，呼吸和代谢作用旺盛，并释放水分，可能导致“出汗”现象。**
- Long after-ripening period: For about two months after harvest, respiration and metabolic activity remain strong, releasing moisture, which may result in a “sweating” phenomenon.

- **吸湿性强：无外壳保护且含亲水物质，易吸收环境水分。吸湿后麦粒软化，易滋生霉菌和害虫，需严格控制水分（≤12.5%）。**
- High moisture absorption: Without an outer protective shell and containing hydrophilic substances, wheat easily absorbs moisture from the environment. After absorbing moisture, wheat grains soften and become prone to mold and pests. Moisture content must be strictly controlled (≤12.5%).

- **耐热性强：高温（50-55℃）下保持活性，短期高温处理（如54℃持续10天）可杀虫灭菌而不影响品质**
- Strong heat resistance: Remains viable at high temperatures (50–55°C). Short-term high-temperature treatment (e.g., 54°C for 10 days) can kill pests and sterilize without affecting quality.

- **耐贮性好：完成后熟的小麦呼吸微弱，常温下可安全储藏3-5年，低温（≤15℃）下可延长至5-8年。**
- Good storability: Once after-ripening is complete, wheat has weak respiration and can be safely stored for 3–5 years at room temperature. Under low temperatures (≤15°C), storage life can be extended to 5–8 years.
- **易感染虫害：小麦易受麦蛾、玉米象等害虫侵袭。**
- Susceptible to pest infestation: Wheat is prone to damage from pests such as Angoumois grain moth and maize weevils.

玉米 Maize

- **籽粒成熟度不均匀和水分高：收获季气温低、果穗苞叶阻碍干燥，水分通常高达20%-35%，同一果穗顶部与基部籽粒成熟度不均；**
- Uneven kernel maturity and high moisture content: moisture content typically ranges from 20% to 35% due to the low temperatures during the harvest season and drying impediment caused by husks. Within the same ear, the maturity of kernels at the tip and base is uneven. Within the same ear, the maturity of kernels at the tip and base is uneven.

- **胚部体积大：占籽粒体积约1/3、重量8%-15%，含大量可溶性糖（30%以上），疏松组织，吸湿性强；**
- Large germ volume: The germ accounts for about one-third of the kernel volume and 8%–15% of the weight. It contains a high level of soluble sugars (over 30%), has a loose structure, and is highly hygroscopic (prone to absorbing moisture).

- **呼吸旺盛：呼吸强度可达小麦的8-11倍，易引发积热；**
- Vigorous respiration: Respiration intensity can be 8–11 times that of wheat, making it prone to heat accumulation.
- **脂肪含量高：胚部集中77%-89%的脂肪，不饱和脂肪酸多，易酸败且酸败始于胚部；**
- High fat content: The germ part contains 77%-89% of the fat, with a high proportion of unsaturated fatty acids, making it prone to rancidity, and the rancidity process typically begins in the germ.

- **易霉变与虫害：胚部营养丰富且带菌量大，霉菌（如黄曲霉、镰刀菌）极易繁殖，生成毒素；易受玉米象、谷蠹等害虫侵染。**
- Susceptible to Mold and Pest Infestation: The germ is nutrient-rich and carries many fungal spores. Molds (such as Aspergillus flavus and Fusarium) multiply easily and produce toxins. Corn is also susceptible to pests such as maize weevils and grain borers.

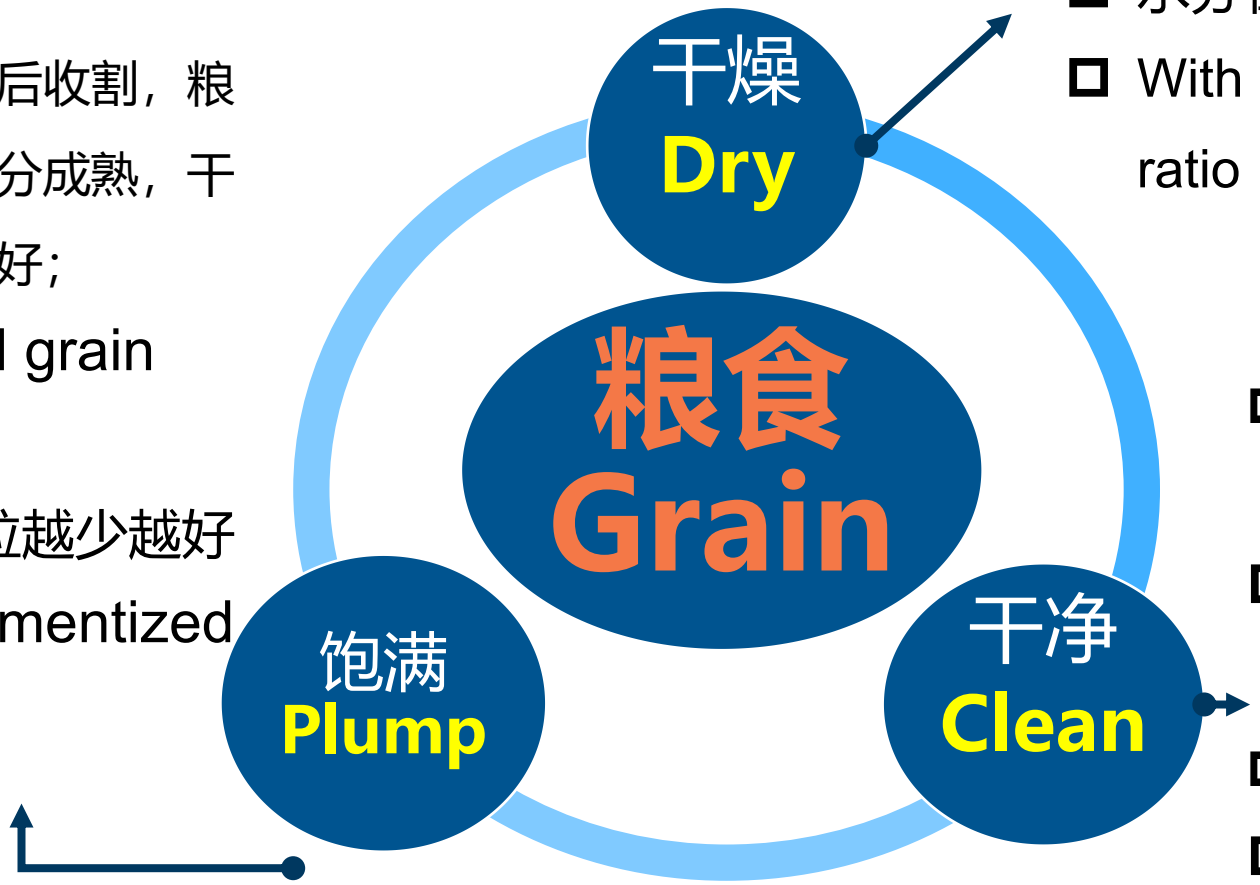
玉米储藏关键：
控制温湿度并防虫、防霉。
Key to maize storage:
Control temperature and humidity to prevent pests and mold contamination.

安全储存对粮食的基本要求
Basic requirements for safe grain storage

- 场地要干净、干燥。
- Dry and clean place.
- 水分在安全水分以内。
- With a safe water ratio

- 应充分成熟后收割，粮食的籽粒充分成熟，干瘪粒越少越好；
- Well-filled grain

- 粮食破碎粒越少越好
- Less fragmentized grains



- 杂质少。粮食中秸杆、谷壳、杂草、泥土、石块等要清理干净；
- Less Impurities without straw, husk, weeds, dirt and stones
- 可用手工、风车、过筛、风力等方法
- By hands, windmill, sieving, etc.

- ✓ 储粮装具内：清洁卫生，无虫源。
- ✓ Inside the grain container: Should be clean, sanitary, and free of pest sources.
- ✓ 装具底部：应有防潮垫或仓底距离地面一定高度，能保持粮仓的干燥、防潮。
- ✓ Container bottom: Should be equipped with a moisture-proof pad or elevated a certain height above the ground to maintain dryness and prevent dampness.
- ✓ 装具整体：应具有防鼠功能。
- ✓ Entire container: Should have rodent-proof features.

对仓房、装具的要求
Requirements for Storage Facilities and Containers

做好隔离
Ensure Proper Separation

有虫粮和无虫粮要分开，陈粮与新粮要分开。
Grain with pests must be separated from pest-free grain.
Old grain must be stored separately from new grain.

储存注意事项 Storage Precautions

（一）稻谷

- 防止高水分稻谷发芽；
- 及时透气通风，避免粮堆温差；
- 及时检查粮情；
- 注意防雨、防虫和防鼠。

1. Paddy

- Prevent sprouting due to high moisture content;
- Ensure timely ventilation to avoid temperature differences within the grain pile;
- Inspect grain condition timely;
- Pay attention to protection against rain, pests, and rodents.

储存注意事项 Storage Precautions

（二）小麦、玉米

- 严格控制水分；
- 小麦可热入仓密闭储藏；
- 低温密闭储藏；
- 及时检查粮情；
- 注意防雨、防虫和防鼠。

2. Wheat and Maize

- Strictly control moisture content;
- Wheat can be hot-loaded into a sealed silo for storage;
- Store at low temperatures in sealed conditions;
- Inspect grain condition timely;
- Pay attention to protection against rain, pests, and rodents.

提醒农户注意：

- 储藏场所应远离潮湿的环境；
- 储粮的装具等也要清理干净；
- 装具周围不要堆放杂物；
- 储存期间要定期查看。

Reminders for farmers:

- Storage sites should be kept far away from damp environments;
- Grain containers and related equipment must be cleaned and kept dry;
- Do not pile miscellaneous items around the containers;
- Regular inspections should be conducted during the storage period.

定期检查
Regular Inspection

发现问题及时处理。
Identify problems and solve them promptly .

- 粮堆温度检测 Grain pile temperature detection

  检测方法： 通过将手伸进粮堆进行感官检测。

  Method: Put the hand into the grain pile for sensory inspection.

- 水分检测 Moisture content measurement

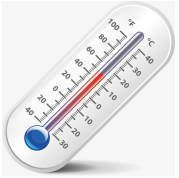
  检测方法： 通过手抓或牙咬进行感官检测。

  Method: Grab with the hand or bite with the teeth for sensory inspection.

- 虫口密度检测 Insect density mornitoring

  检测方法： 定期检查有无害虫发生（可用筛子）。

  Method: Regularly check the presence of pests (e.g., using traps).



03

Storage Equipment-- Small Steel Silo

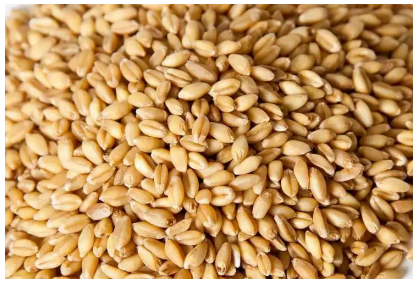
储存的装具--小钢仓

适合稻谷
储存的仓型
Paddy Storage
Types

小钢仓
Small Steel Silo

镀锌铁皮仓
Galvanized Iron Silo

木骨架金属网仓
Wooden Frame Metal
Mesh Silo



适合小麦
储存的仓型
Wheat Storage
Types

小钢仓
Small Steel Silo

PVC软体仓
PVC Soft Silo

彩钢板方形仓
Color Steel Panel
Rectangular Silo

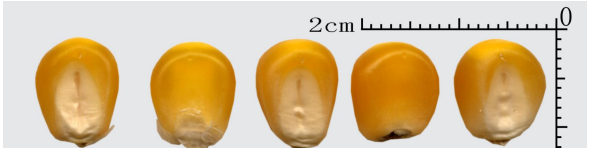
适合玉米储存的仓型 Maize Storage Types

小钢仓
Small Steel Silo

镀锌铁皮仓
Galvanized Iron Silo

钢骨架矩形玉米穗储粮仓
Steel Frame Rectangular Maize Ear Storage Silo

玉米粒储 Maize Kernel Storage



玉米穗储 Maize Ear Storage

对于小农户储粮（适用三种粮食）
For Smallholder Grain Storage (Suitable for Three Major Grains)

Small Steel Silo

彩钢板组合仓
Small Steel Silo

- **材质为0.4毫米厚彩钢板**
- 0.4 mm thick pre-painted steel sheet
- **价格约400-500元/套, 每立方米造价为260-350元**
- Price: 400-500 CNY/set (55-69 USD/set). Cost: 260-350 CNY/m^3 (36-49 USD/m^3)
- **容积1~1.5m^3，装粮数量约560公斤~850公斤**
- Volume1-1.5 m^3 to store 560-850kg grains
- **适合储藏安全水分的稻谷**
- Suitable for storage of paddy within safe water content

彩钢板组合仓
Small Steel Silo

该仓一般为3层，高度约1.35米

The silo is generally 3 layers, height of about 1.35 meters.

原因 Why this silo

- 节省材料，因地制宜
- Materials saving. Adaption to local conditions.
- 考虑到装粮方便和安全
- Grain loading: convenience and safety.

特点 Characters

- 防潮、防鼠、耐用（>15年）
- Moisture-proof, rodent Control and durable. Service life exceeds 15 years.
- 便于规模化、流水线加工生产
- Facilitate large-scale and assembly line processing and production

04

Research and Development Process of Small Steel Silos

小钢仓的研发历程及发展

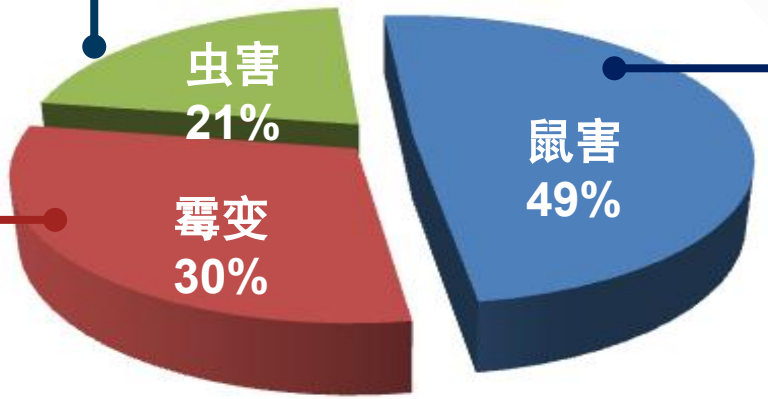
2005年前中国农户储粮情况
Smallholder grain storage in China before 2005

据2005年调查，储粮损耗约占农户储粮的8~10%。

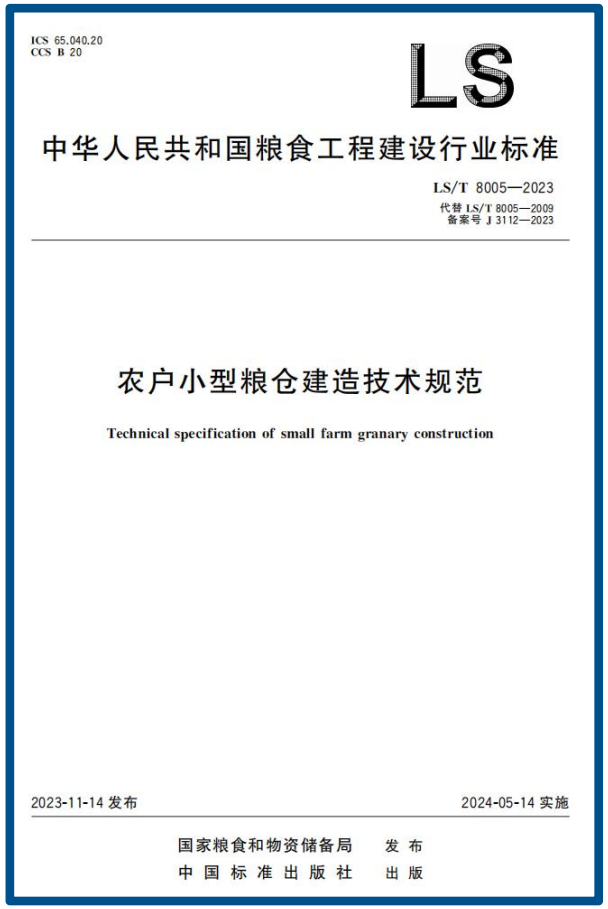
According to the survey in 2005, the loss of grain storage accounted for about 8~10% of the grain stored by smallholders.

其中鼠害损失约占总损失量的49%，霉变的损失约占总损失量的30%，虫害的损失约占总损失量的21%。

The loss of rodent infestation accounted for about 49% of the total loss, the loss of mildew accounted for about 30% , and the loss of pest infestation accounted for about 21% .



我国国粮局组织我们进行小粮仓和服务模式的研究
The National Food and Strategic Reserves Administration (NAFRA) organised us to conduct research on small grain silos and service models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中华人民共和国粮食工程建设行业标准

LS/T 8005—2023

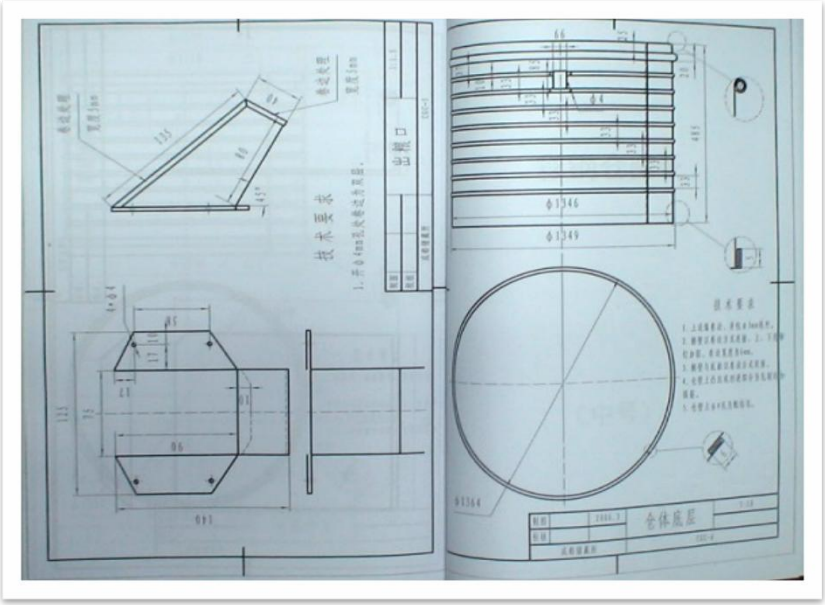
代替 LS/T 8005—2009
备案号 J 3112—2023

农户小型粮仓建造技术规范

Technical specification of small farm granary construction

2023-11-14 发布　　2024-05-14 实施

国家粮食和物资储备局　发布
中国标准出版社　出版



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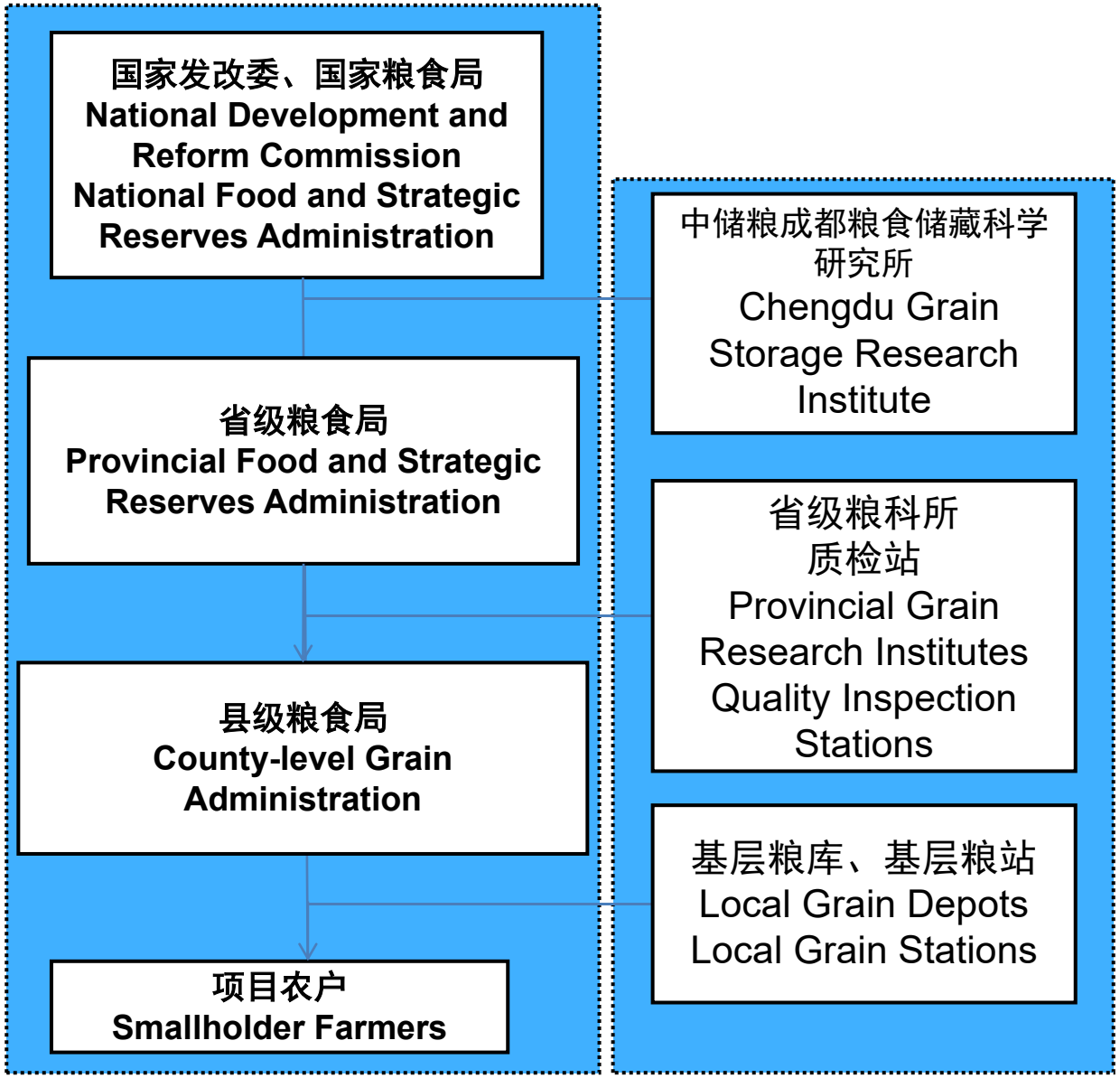

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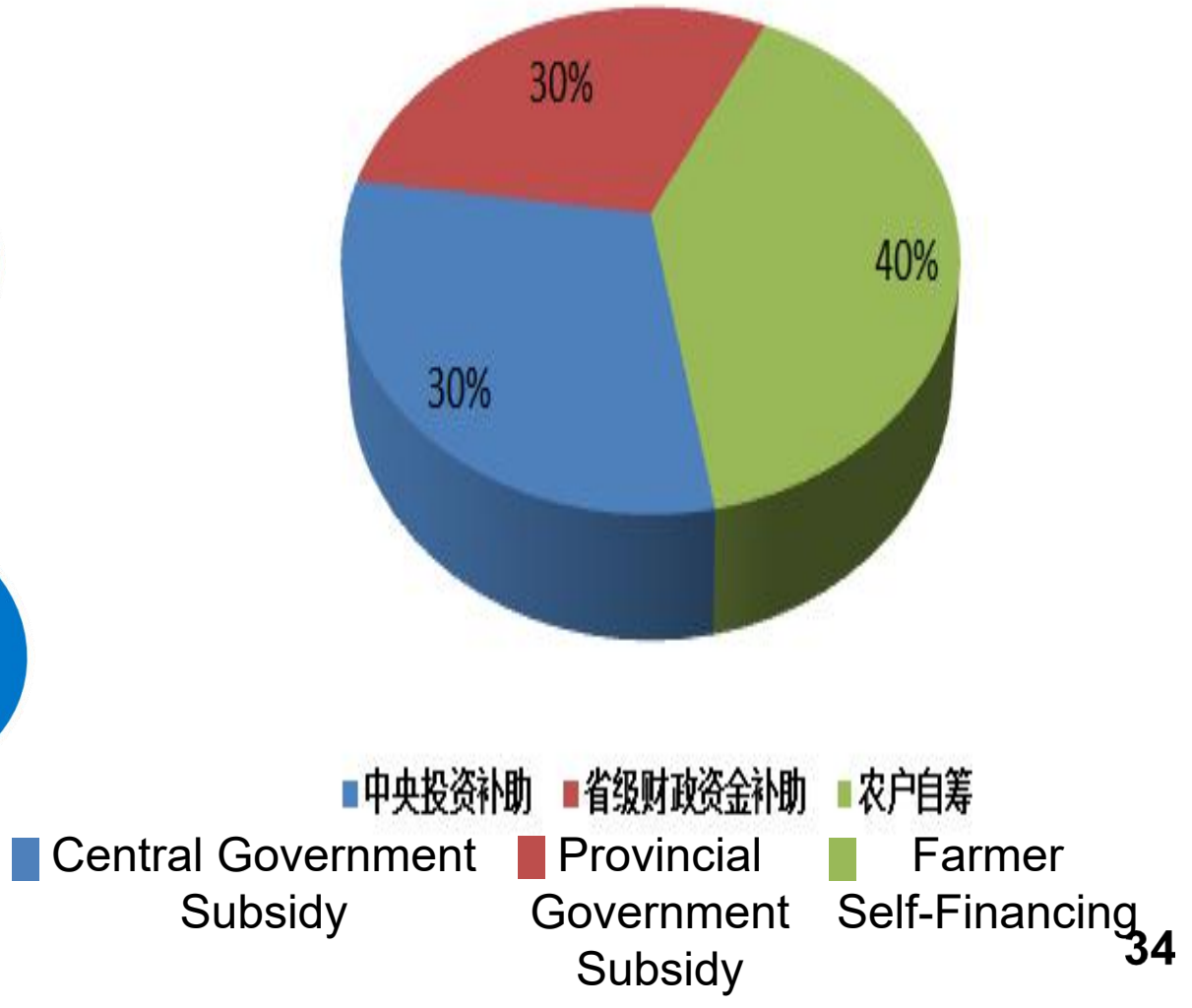


上世纪九十年代
1990s

上世纪末
Late 1990s

2006年
2006

2015年
2015

2023年
2023

中国农业大学
China Agricultural University

【包括收获、储藏、运输等环节】
(including parts of grain harvest, storage, transport, etc.)

各省农业部门
Provincial Agricultural Departments

【问卷调查】
(Questionnaire surveys)

成都储藏院等
SINOGRAIN Chengdu Grain Storage Research Institute and others

【入户调查】
(Household surveys)

成都储藏院等
SINOGRAIN Chengdu Grain Storage Research Institute and others

【入户调查】
(Household surveys)

国家粮食和物资储备局
National Food and Strategic Reserves Administration

【统计调查】
(Statistical surveys)

案例 Case Study: Mr. Huang Mingshui from Sichuan Province

2008年
In 2008

四川广汉锦花村小钢仓
Small steel silo was introduced to Mr. Huang in Jinhua Village, Guanghan, Sichuan Province

2013年
In 2013

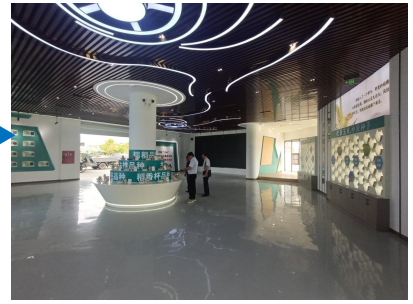
黄明水（家）种植100亩地
50吨小型钢板仓
Mr. Huang had 100 mu (6.67 hectares) farming lands and used 50-ton small steel silos

2015年
In 2015

在自家晒场使用小型碾米设备加工销售自产大米
Mr. Huang had the small-scale rice milling equipment at his own drying yard to process rice, and sell his homegrown rice to the market

2020年
In 2020

继续租地500亩成立农业合作社
Mr. Huang continued renting 500 mu (33.35 hectares) farming land and establish the agricultural cooperative



2022年 In 2022

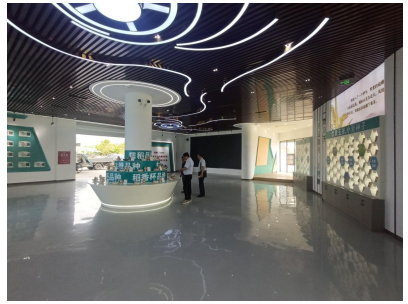
继续租地、育秧、农机，
与人合作扩大农业合作社

Mr. Huang continued land rental, seedling cultivation, and agricultural machinery operations. Cooperate with others to expand agricultural cooperatives.

List of Socialized Agricultural Services

黄明水，现在负责种地，辛苦着、快乐着、有成就感地工作着，共享成果

Mr. Huang Mingshui is now responsible for farming , working diligently, joyfully, and with a strong sense of accomplishment. **share outcomes**



2022年 In 2022

继续租地、育秧、农机，

农业合作社扩大

1. 高标准农田
2. 大米加工厂
3. 品牌展示厅、农药、种子等销售点
4. 粮仓
5. 农机库房
6. 农户居住点

1. High-standard farmland
2. Rice processing plant
3. Brand showroom, pesticide outlets, and seed retailers
4. Grain storage facility
5. Agricultural machinery shed
6. Farmer residential area

广阔农村，大有作为
The vast countryside holds great potential for achievement.

国家储备非常重要，但是农村储粮节粮减损也是很重要的

National grain reserves are critically important, but grain storage and loss reduction in rural areas are equally essential.

这是我们下一步目标，现在正在做

This is our next objective—and it's already underway.

Architectural Visualization of an Agricultural Comprehensive Service Centre

WFP World Food Programme

2 ZERO HUNGER

Thank You

WFP-China SSC
Knowledge Sharing Platform

Cloud School

Sharing for Learning