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Grain Processing and Storage Technology – Lessons from China Visit

A. V. Ramanjaneyulu

Agricultural Research Station (Professor Jayashankar Telangana State Agricultural University), Tornala, Siddipet, Telangana (502 114), India

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Corresponding Author

A. V. Ramanjaneyulu
e-mail: avr_agron@rediffmail.com

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Abstract

Grain is the primary element of human existence. Grain reserves are important for food security of any nation. Increasing population, food wastage, demand for diversity of food products, occurrence of natural calamities and climate change are necessitating proper grain storage and processing facilities to ensure constant food supply through replacement of traditional storage methods. Warehouses with modern and sensor based drying, storage and processing facilities are need of the hour. Establishment of mechanized storage and processing facilities aided by solar power helps to establish sustainable and eco-friendly infrastructure. Such systems help reduce grain storage losses and maintain grain quality. Further, Governments should take steps to equip newly set up food parks in India with advanced storage and processing framework. However, small holder farmers can adopt cost-effective hermetically sealable and mechanically durable methods rather than conventional approaches.

Introduction

Grain is very important for national economy and people's livelihood. It plays a greater role in economic and social development, prosperity and stability of a country. People will be rich, country will be strong and world will be peaceful with sufficient food. Otherwise, society will be turbulent and regime will be unstable. In history, there were many dynasties with abundant grain and at the same time, there were many instances of regime change because of grain shortage, which explains the essentiality of grain reserves. Further, grain is the essential material for war and the pre-requisite for victory. Thus, developing grain production, preservation and ensuring food security are of paramount importance for human existence. Farmers and traders have been following traditional methods of grain storage since many years, while, its' processing is at infancy stage in India. Hence, this scientific report is written based on my visit to advanced grain storage and processing industries in China, which can be replicated in India too.

Visit to China

I have undergone a month long training course at 'Yuan Longping High-tech Agriculture Co. Ltd.', Changsha city, Hunan province, China, as nominated by the Professor Jayashankar Telangana State Agricultural University (PJTSAU), Hyderabad, Telangana, India. The training was organized by the company from 28th August, 2019 to 26th September, 2019 with financial support from Ministry of Commerce, China with an objective of strengthening cooperation and promoting trade in agricultural technology between China and India. There were

class room lectures and also exposure visits to the industrial establishments. Theoretical aspects of primary and secondary processing technology for rice, warehouse technology, overview of food quality standards, post-harvest grain safety problems, application of high efficiency equipments in grain storage and transportation, IT enabled automation of processing technology and utilization of by-products of rice, maize and wheat, standards and procedures of maize variety (hybrid) certification and hybrid rice technology in China were discussed.

Innovative Establishments in China

I have visited the following institutes and industries in Changsha and Zhengzhou cities and learnt about innovative infrastructural facilities available for storage and processing of grains and production of by-products (Figure 1 to 10).



Figure 1. Vertical silo in Sinograin company, Changsha



Figure 2. Jigantic machine to load and unload at ports



Figure 3. Mechanized rice and wheat milling units at Tianxiang group company in Zhengzhou city



Figure 4. Sensor based bulk cold storage



Figure 5. Solar panels on warehouses



Figure 6. Grain loading through conveyer belts



Figure 7. Biscuits and Bun



Figure 8. Rice buns



Figure 9. Artificial corn



Figure 10. Artificial rice

Need for Modern Storage

Modern storage structures (Bagged storage system, silo storage system, air tight storage system, aerated storage system, low temperature storage system, controlled atmosphere storage system, damp grain storage system with chemicals, solar aided intelligent monitoring systems, etc.) are needed-

- To protect the grain/ food from biotic and abiotic factors (Figure 11). Post harvest losses of grains vary from 1-2 % in the developed countries and 20-50 % in less developed nations (Jayas, 2012). But in India, 10–15 % of food grain is generally lost in a single season. A total 12-16 million metric tons of food grains (Rs. 50,000 crores) are spoiled every year due to improper storage, which is sufficient to feed the 33% population.
- 10–20 % higher market price is possible during offseason, which improves economic returns of the farmers due to proper storage.
- Can be used to face natural calamities like earthquakes, droughts and floods.
- To export good quality products to other states and countries.
- Traditional storage structures (Bukhari, kothar, morai, mud bin, muda type, kananj, kuthala, bag, metal bins) are obsolete, less durable and unsafe besides less storage capacity.
- To store seed for ensuing crop seasons.
- To store large quantity of produce and also ensure grain quality.

Table 1: Various institutes and industrial units visited in China

| S.No. | Institute/Industry (Date of visit) | Location | Observations/Infrastructure visited |
|-------|--|-----------|--|
| 1 | Gaoquiao Breeding experimental base and Gaoquiao Agriculture and Scientific Centre and Scientific Observing and Experimental station of land conservation (29-08-2019) | Changsha | <ul style="list-style-type: none"> • Soybean crop all along rice field bunds and vegetables along the field bunds • Cement lined irrigation channels Rain water harvesting from series of polyhouses |
| 2 | Chinese National hybrid Rice Research Centre, Changsha and Hybrid rice museum and video (06-09-2019) | | <ul style="list-style-type: none"> • Hybrid rice museum showing the history of evolution of hybrid rice in China |
| 3 | National Engineering Laboratory for wheat and corn further processing (17-09-2019) | Zhengzhou | <ul style="list-style-type: none"> • High-tech machinery used for manufacture of by-products like flour, noodles, steam bread making, wax, artificial rice and corn etc. • Facilities for wheat milling, oil refining and fractionation, cereal milling technology, and wheat noodles • Laboratory for food sensory evaluation |
| 4 | Henan University of Technology (17-09-2019) | | <ul style="list-style-type: none"> • Water storage and conservation • China Grain museum highlighting importance of grain in food production and supply to the people during different phases of history since ancient time (10000 yrs ago to till date) |
| 5 | Hunan Grain group (04-09-2019) | Changsha | <ul style="list-style-type: none"> • Warehouses, other storage structures like silos/squat silos and processing plant managed by Hunan Grain Group. Nearly 48,000 solar panels are installed on the roof of warehouses which can save approximately 10 million yuans per year • Sensor based automatic monitoring system • Visited port located on the banks of Xinjiang river with facilities of mechanical lifting of materials with gigantic machines from off-shore to the on-shore. |
| 6 | Chen Liang Ji rice processing machinery company ltd (a part of Hunan Chenzhou grain and oil machinery Co., Ltd.,)(09-09-19) | | <ul style="list-style-type: none"> • Intelligent Paddy primary and secondary processing facilities • Paddy drier manufacturing unit |
| 7 | Xiangliang mechanical Co. Ltd., Changsha rice processing company in Hunan Grain Group(11-09-2019) | | <ul style="list-style-type: none"> • Manufactures high quality rice milling equipments with low energy consumption, high precision polishers, grain storage units, grain process factories, wheel movable grain loaders/unloaders, truck bulk grain unloaders, belt conveyers, high efficiency primary cleaner, grain storage seal window and door, silo conveyers and other conveyers • Grain suckers and central monitoring units • Large capacity vertical silos and squat silos • High efficiency mechanical equipment for rice milling processing, grain storage units (open floor with air conditioning; sensor controlled silos) and transportation |

Table : Continue...

| S.No | Institute/Industry (Date of visit) | Location | Observations/Infrastructure visited |
|------|---|-----------|--|
| 8 | Yuan Jiang Shi Mi Zhi Chun Rice Industry Co. Ltd., (14-09-2019) | | <ul style="list-style-type: none"> • Has the capacity to process 10,000 MT of paddy. The mill has permanently fixed sensor aided remote station which can be operated by a single person • Visited Hunan Xinshi rice industry Co. Ltd., where in I have seen all the machinery starting from miller, size grader, colour starter and automatic packing and finally conveyer belt carrier upto the trucks |
| 9 | Tofoto company (17-09-2019) | Zhengzhou | <ul style="list-style-type: none"> • 100% mechanized rice processor (for noodles and bun) |
| 10 | Henan Tianxiang group (m-Sun) (18-09-2019) | | <ul style="list-style-type: none"> • Fully mechanized world class hi-tech single control machinery for processing of wheat and maize products like flour, noodles, etc. with machinery with a turnover capacity of 600 and 1200 t/day |
| 11 | Sinograin company (25-09-2019) | Changsha | <ul style="list-style-type: none"> • Vertical silos equipped with full mechanization and centralised IT enabled control. Each silo has a storage capacity of 1.0 lakh tonnes • The grain loading and unloading is done with the help of conveyer belts and sucking machines • Visited a nearby port with seed loading and unloading machines from and to the ships and trucks |

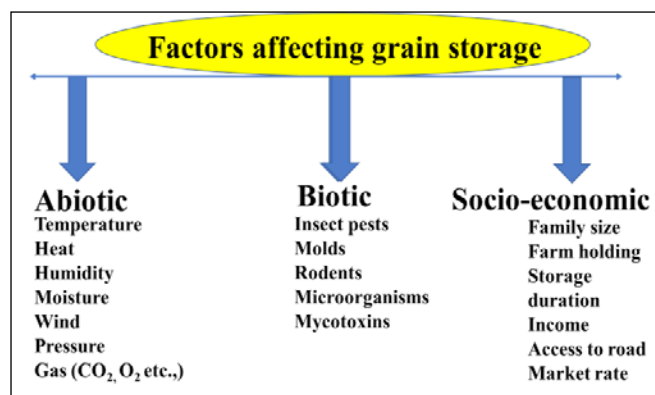


Figure 11: Factors affecting grain storage

Need for Processing

Processing industry is the basic industry of agricultural product processing. With the progress of time, increase in productivity and population, constant development of processing technology is needed-

- To handle over production.
- To reduce wastage.
- To facilitate easy and safe export.
- To increase diversity of products and satisfy needs of millions of people.
- To fetch better price.

Sustainable and eco-friendly grain storage and processing units are very important because places of consumption are different from that of places of production and processing. Further, production is seasonal, but, consumption is year round.

Scope for Grain Storage and Processing in Telangana

In Telangana, rice area increased by 96% during 2019-20 (32.19 lakh ha) as compared to that of 2018-19 (16.4 lakh ha) due to huge irrigation potential created through several lift irrigation projects such as Kaleshwaram etc. (Umarani and Ramanjaneyulu, 2020). This is likely to increase enormously during ensuing years. Likewise, 32% (5.86 lakh ha) and 35.8% more area (4.13 lakh ha) was planted under cotton and pigeonpea, respectively during *kharif* 2020 due to government policy of implementing and promoting *rythubandhu* scheme linked 'Regulated crop planning' across Telangana. Consequently, huge production of these crops is expected as compared to the yesteryears. In view of this, storage and processing technologies are the need of the hour. The technology developed by China can be followed by us in India either in original form or modified form according to our needs.

Agriculture

- Porridge, rice bun, puffed rice (*Murmura*), rice flakes, rice flour, artificial rice.
- Processing of corn (corn syrup, corn flour, corn flakes) and soybean (soya milk/sauce, meal maker, protein, paste, hydraulic lubricants/ fluids, molasses, yogurt, lecithin.
- Cotton Seed Oil, *nutricereals*.

Horticulture

- Frozen fruit processing, fruit grading, packing, juice extraction, processing of Gherkins, pickles, ketchups,

squashes, turmeric oil extract, powders.

Poultry

- Chicken Processing, Egg grading, Packing and egg powder units.

Dairy

- Integrated large dairy farms, dairy processing units, milk powder, and milk by products such as paneer, cheese, butter etc.

Livestock

- Meat processing units for export, sheep and goat processing units for local consumption.

Others

- Ready to cook and eat jams, jellies, fruit pulps, biscuits, noodles etc.

Scope for Grain Storage and Processing in India

India has the largest diversified production base and has a growing food industry. Our country is-

- 1st in milk production, 2nd in production, consumption and export of spices, production of food grains, fruits and vegetables.
- Government has started *NiveshBandhu*, an investor facilitation portal to assist investors with a special fund of USD 285 Mn in NABARD.
- The Ministry of Food Processing Industries, India has notified 253 designated food parks in different states for the purpose of availing affordable credit from a special fund with NABARD.
- NABARD has already sanctioned a term loan of around USD 65.27 Bn to 11 Mega Food Park projects as of March 2019.

Lessons to be Learnt from China Visit

- Post harvest technology (processing) for producing innumerable no. of by-products.

- 100% Mechanization in warehouses and processing industries.

- Intelligent/ sensor based cleaning, grading, sorting, drying, milling, vacuum packaging etc.

- Harnessing renewable source of energy i.e. solar power.

- Growing soybean on rice filed bunds.

- Hybrid rice technology which accounts for nearly > 60% of rice production in China.

- Capacity building for the industrial units, warehouse people and farmers on grain processing and storage technology in principal crops grown in Telangana.

Conclusion

The grain or food spoilage can be minimized through mechanization, setting up of modern storage and processing methods. Solar energy has to be harnessed as done by Hunan Grain Group, China. Fully mechanized machinery for grain milling, size grading, colour sorting, automatic packing and carrying to trucks for marketing should be established. Sensor based intelligent and automatic monitoring system and mechanical lifting of materials with gigantic machines from off-shore to the on-shore should be adopted in India wherever possible. Complete mechanized processing of China should be replicated in India.

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