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Different Types of Grain Storage Structures for the Betterment of Livelihood of Indian Farmers

Ashok[1*], Basave Gowda[2] and Shakunthala, N. M.[3]

[1]PhD Scholar, [2]Professor (SST) and Special Officer (Seeds) and [3]Professor and Head,

Department of Seed Science and Technology, UAS, Raichur-584104

*Corresponding Author E-mail: npbashokreddy@gmail.com

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ABSTRACT

Storage implies preserving. It is the process of carrying surplus production for future consumption. It includes all types of storage, whether traditional/indigenous and scientific methods of storage, whether controlled or ambient and maintained by the private or public agencies. To minimize storage losses, low cost grain storage is the need of the hour. Indigenous grain storage structures with some modification provide better alternative to costly modern storage structures. The selection of these grain storage structures depends on several factors. Here in lies the significance of improved storage structures and scientific storage of grains in form of warehouses. These provide safe and economical means of grain storage for long durations. In India, 60-70 per cent of food grain produced is stored at home level in indigenous storage structures. For a our country like India, it is necessary to minimize the storage losses. As of now storage losses in India is 10 per cent which is abnormally high as compared to other developing countries. Need of the hour is to strengthen traditional means of storage with modern inputs and to provide cheaper storage to farmers so as prevent enormous storage losses. On the other hand, warehousing means scientific facilities for storage of commodities, generally combined with the elements of trade and profit. The storage is, thus, a broader term and warehousing forms a part of it. In this paper traditional as well as modern methods of storage structures are discussed.

Key words: *Traditional storage structures, Bins, Bags, CAP (Cover and Plinth) and Silos.*

INTRODUCTION

Food grains form an important part of the vegetarian Indian diet. Grain production has been steadily increasing due to advancement in production technology, but improper storage results in high losses in grains. According to World Bank Report, post-harvest losses in India amount to 12 to 16 million metric tons of food grains each year, an amount that the World Bank stipulates could feed one-third of India's poor. The monetary value of these losses amounts to more than Rs 50,000 crores per year[5].

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Natural contamination of food grains is greatly influenced by environmental factors such as type of storage structure, temperature, pH, moisture, *etc*.,[4]. Types of structure used, length and purpose of storage, grain treatment (eg parboiling) and pre-storage practices are all important variables affecting storage losses. The importance of these regional and crop variations immediately determines certain necessary characteristics of crop storage research[1] micro-organisms. A large number of insect pests have been reported to be associated with stored grains. The occurrence and numbers of stored grain insect pests are directly related to geographical and climatic conditions.

For a country like India, it is necessary to minimize the storage losses. As of now storage losses in India is 10% which is abnormally high as compared to other developing countries. In India, 60-70% of food grain produced is stored at home level in indigenous storage structures. Grain is generally stored either in bags or in bulk. A combined system of bag-cum-bulk storage is also practiced in some parts of the country. In villages the bulk storage system is more common than the storage in bags which is considered to be a practicable method· of storing grain in the government godowns as well as in trade. There are main following four types of storage structures for storage of grains.

1. Traditional storage structures
2. Improved storage structures
3. Modern storage structures
4. Farm Silos

1. Traditional Storage Structures

In this types of storage structures the grain is generally stored in bulk. This types of storage structures having generally capacities between 1 to 50 tonnes. The storage of grain is generally done in one of the following storage structures in the different rural and urban regions of India in bulk as well as in bag storage.

a. Morai type storage structures
b. Bukhari type storage structures
c. Kothar type storage structure
d. Mud Kothi type storage structure
e. Muda type storage structure
f. Kanaj type storage structure
g. Kuthla type storage structure
h. Metal/ Steel bin type storage structure
i. Bag type storage structure

a. Morai type storage structure

Morai type of structure is used for the storage of paddy, maize and sorghum (jowar) in the rural areas of eastern and southern regions of India. Its capacity varies from 3·5 to 18 tonnes. These structures are very similar to the shape of an inverted cone. They are placed on a raised platform supported on wooden or masonry pillars. The improved type of structure consists of a circular wooden plank floor supported on pillars by means of timber joints. The planks are joined together with lap joints. All around the wooden floor a 22 gauge corrugated metal cylinder of 90 cm height is nailed to it. The edge of the cylinder is flushed with the bottom end of the floor. Inside the cylinder, 7·5 cm diameter ropes made of paddy straw or similar material are placed, beginning from the floor level upto a height of 90 cm. Then bamboo splits are placed vertically along the inner surface without leaving any gap between them. The height of the bamboo splits is equal to the total height of the structure. Keeping the bamboo splits in position, the grain is poured in up to the height of the metal cylinder. By then the bamboo splits are held erect in position. Now the winding of the rope as well as the pouring in of grain are done simultaneously. This process continues tiIl the required height is attained. The top most ring of the rope is secured in position by tying to the lower four rings. To provide a smooth surface, about 1 cm thick layer of mud plaster is applied over the rope. A conical roof is placed on the top of the structure having an ample overhang all around.

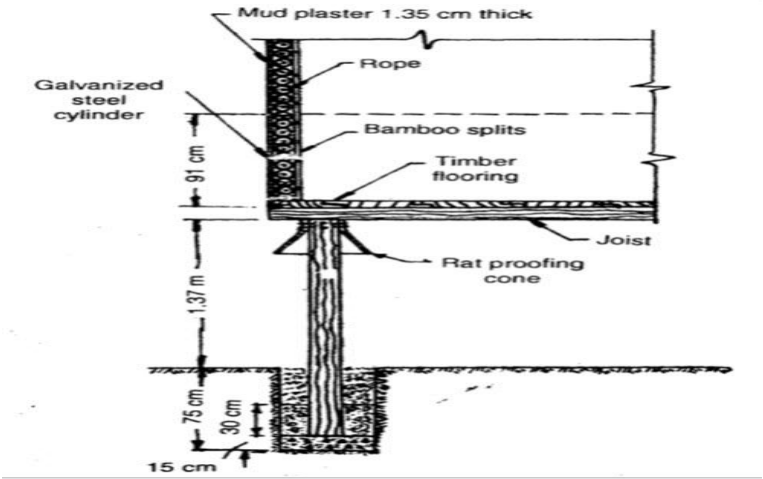

Fig. 1: Morai type grain storage structure~vertical section

a. Bukhari type storage structure

Bukhari type storage structures are cylindrical in shape and are used for storage of sorghum, wheat, padd)" Bengalgram, maize etc. Bukhari structures generally have capacities between 3.5 to 18 tonnes, however, smaller capacity structures also exist. This may be made by mud alone or by mud and bamboo. The cylindrical storage structures are raised above the ground by wooden or masonry platform. The floor of the bin is made either by timber planks or by bamboo splits, plastered over with mud rilixed with dung and paddy straw. The walls of the structure are made of timber or bamboo frame work and bamboo matting. Over the walls, mud-straw plaster is applied on both sides. An overhanging cone type roof is provided on the cylindrical structure. The roof is generally made of bamboo framework and straw. In improved bukhari type structure, the basic shape remains the same but the material and method of construction have been improved to make the structure more safe and durable. The circular floor of structure is either made of wooden planks joined by lap joints or by a double layer of bamboo splits closely set at right angles to each other. Over the floor, about 5 cm thick mud plastering is provided. The walls of structure are made of two sets of strong bamboo framework. The inter-space is filled with mud. The walls on both sides are plastered with mud. The roof is conical and made of bamboo frame-work and covered with paddy straw or similar other thatching material. The top of the conical roof is covered with 4 to 5 cm thick mud layer to provide additional protection from rains. The structure is raised on timber or masonry pillars to a height of about 1.5 m from ground level. Rat proofing cones are placed on all the four pillars to avoid rats entering the storage structure.

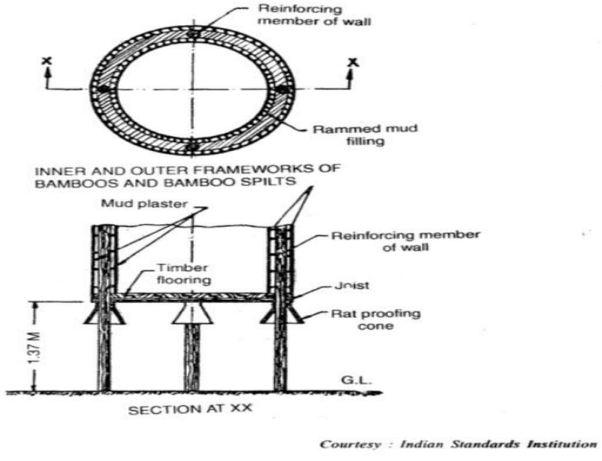

Fig. 2: Bukhari type Grain Storage Structure - Vertical Section

a. Kothar type storage structure

These are used to store paddy, maize, sorghum, wheat etc. Their capacity varies between 9 to 35 tonnes. The storage structure is box like made of wood and raised on pillars. Both the floor and walls are made of wooden planks whereas the thatched or tiled roof is placed over it to protect the grains from the sun or rain. The improved Kothar structure is generally made of 5 cm thick wooden planks and beams. The walls and floor are made in such a way that no gap exists between the planks. The gabled roof on the top may be made of planks or corrugated metal sheets and should be sufficiently overhang on all sides. The storage structure is raised on timber post to a height of about 1.5 m above the ground. Rat proofing cones are provided on all posts to avoid entry of rats in the structure. (Fig.35.3)

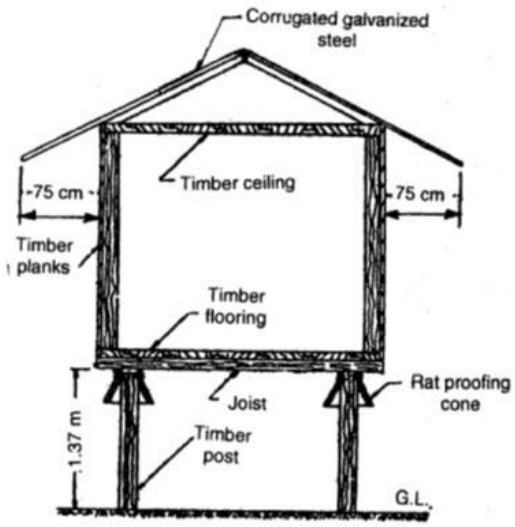

Fig. 3: Kothar type Grain Storage Structure - Vertical Section

a. Mud Kothi (Mud bin)

These storage structures are quite common in rural areas for storage of grains and other seeds. The capacity of such storage structures varies from 1 to 50 tonnes. These are made from mud mixed with dung and straw. These Kothies are generally rectangular in shape but cylindrical Kothi is also common in some region. There are many sizes and dimensions of Kothi made for storing grains.

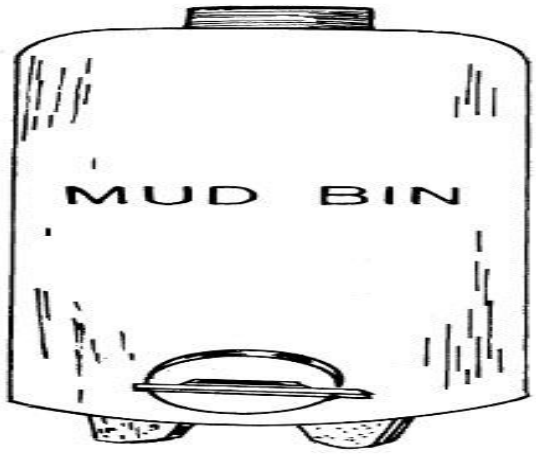

Fig. 4: Mud type of storage Structure

These are in use for storing grains in the rural areas of Bihar. The capacity of muda varies between 1 to 3 tonnes. It is being made of "Narai" ropes. The shape of muda is cylindrical and being made in various sizes.

b. Kanaj type of Storage Structure

These storage structures are very common in the rural areas of Karnataka and Maharashtra for storage of grains. The capacity of Kanaj varies between 1 to 20 tonnes. It is being made by bamboo splits. The shape of storage structure is cylindrical. The walls of storage structure are sealed with mud plaster on both sides. The roof of the structure is conical and thatched. The roof overhang on all sides.

c. Kuthla

These storage structures are very much common in rural areas of Bihar and Uttar Pradesh. These structures are kept inside and made of burnt mud.

d. Bag Storage Structure

These structures are generally used for the storage of 25 to 500 tonnes of grain. The length of the structure is about twice the width or greater than that. A typical floor plan of such a structure large enough to store about 6000 bags (500 tonnes) of grain. Bags of different capacities (35, 50, 75 and 100 kg) with or without inside plastic lining are used. The standard size of a 100 kg bag is 100 cm x 60 cm x 30 cm i.e. length of bag is 100 cm, width of bag is 60 cm and height of filled bag is 30 cm. This bag can store 93 Kg of Wheat and 75 Kg of Paddy.

Fig. 5: Different size of Bags for storage

h. Metal Bin

Bins made of steel, Aluminium R.C.C are used for storage of grains inside and outside the house. These bins are fire and moisture proof. The bins have long durability and produced on commercial scale. The capacity ranges from 50 kg to 10 tonnes.

i. Hagevu: Is an underground structure that is used to store grains. It is a simple pit lined with straw ropes to prevent damage from moisture. In some cases, hagevu is constructed as an indoor structure (with stones). After filling the structure fully, the paddy straw is spread on top as a thick layer and the structure is sealed with mud plaster.

It is however important to note that these indigenous storage structures are not suitable for storing grains for very long periods. Regular mud plastering is required for a variety of indoor and outdoor storage containers and structures for increasing their life span and ensuring safe storage of grains.

2. Improved Storage Structures

Improved storage structures are the storage structures for storage of food grains. In this type of storage structures there are some improvements made in traditional storage structures. This type of storage structures having a higher storage capacity and long term storage of food grains than traditional storage structures. Improved type of storage structures having capacities is generally 1.5 to 150 tonnes. The storage of grain is generally done in one of the following storage structures in the different rural and urban regions of India in bulk, bag as well as bag and bulk storage.

a. Pusa bin

Pusa bin is like other traditional storage structures made of mud. To make the storage structure moisture proof a plastic film is used in all the inner sides of the bin.

b. Brick and cement bin

These type of storage structures are very strong and effect of seasons on these is minimum.

c. Bunker Storage

These type of storage structure is used for long term storage and a larger volume of grains storage.

d. CAP (Cover and Plinth) Storage structures

The word CAP is used for cover and plinth, plinth from the bottom and cover from the top. This type of open storage is considered as transit storage and serves the purpose of storage of food grains in bags for short period.

3. Modern Storage Structures

In India, for larger volume of food grains are to be stored in bulk is 'silo' and conventional godowns (Shed) designed for bagged storage. The godowns side walls are of brick or stone masonry and sloped roofing in asbestos or Corrugated Galvanized Iron (CGI) sheets over steel trusses. Silos are constructed from steel or reinforced concrete. There are a cluster of adjoining silos in any modern large/ capacity processing plant. The modern permanent storage system should be selected for the safe keeping of stored grains and other products. The modern storage structures should be selected on the basis of first on quality and then on cost considerations. There are following types of modern storage structures.

a. Silo type of storage structures

Silos/bins are classified into two groups depending upon the relative dimensions of the container. These are classified as, (1) deep bins and (2) shallow bins.

b. Shallow bins

Squat silos are comes under shallow bins. A squat silo has a wall height to diameter ratio 0.5 or even less. Squat silo can compete with sheds for low-cost quality storage.

c. Deep bins

Vertical Silos are comes under this type of storage structures. There are two types of vertical silos a) Flat bottom vertical silo and b) Hopper bottom vertical silo.

d. Shed

Generally, a horizontal sheds have been used to provide low- cost, large volume storage. For storing grains and other products a very large volume sheds have also been constructed by Central Warehousing Corporation.

4. Farm Silos

Farm silos is a farm structure used to store and protect the animal fodder so that it is preserved in an ideal condition for farm animals. Animal fodder is cut and packed in the air tight silo to allow a partial fermentation to occur. The storage fodder is known as silage. There are two types of farm silos i) Tower silos and ii) Horizontal silos.

a. Tower silos

- Cylindrical Shpe and made of masonary, wood or metal
- Cost of construction is comparatively much higher than that of horizontal type.
- Loading of animal fodder is difficult.
- Mechanical loader or a large capacity of blower is essential.
- This type of storage structures are not recommended under Indian conditions.

b. Horizontal silos

In horizontal silos pit type, bunker type and trench or stake type of storage structures used for storage of animal fodder.

- There are surface as well as below ground (underground) types of storage structures used on most of dairy farms as temporary and permanent storage structures for silage.
- The spoilage of silage and dry matter losses of these silos ranges between 20 to 30 percent.

c. Pit Silos

- Permanent pit silo is a circular deep well which is lined all around the side, and sealed from bottom, so that water may not rise in to it.
- Made in areas where the soil is deep and the water table is very low.

- Made of bricks, stones or concrete, and either cement or lime can be used as a binding material.
- A 22.5 cm thick wall will be used satisfactory up to 15 meter depth.
- The entire surface which is coming in contact with the silage should be plastered to make it smooth, air tight and water tight.
- Simple roof is made over the silo to protect the silage from sun and rain.
- Corrugated metal sheet dome or half pitch roof with ample overhang on all the sides are most economical and provide more space for filling.
- Stairs may be built along with wall for removing silage from the silo.
- The diameter of a silo is usually limited to 6 m and its depth is kept 2 to 3 times that of diameter.
- When the silo is opened for removing the silage, nobody should enter till the gases are removed.

d. Trench Silos

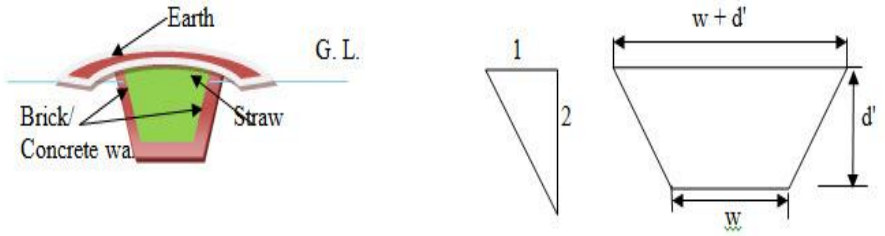

Fig. 6: Cross – section of trench silo showing wall lining

- Unlined trench silo can be made easily without involving any investment on building materials such as brick, cement and sand.
- Unlined silos give more spoilage and are likely to have caved side walls due to excessive rain and tend to become muddy at the bottom. So, lined trench silos are therefore become popular.
- The walls of the trench silos can be lined with brick, concrete or cement plaster with reinforcing wire mesh.
- If possible the silo should be roofed.
- Drains should be made around trench to intercept surface water.
- To facilitate drainage it is desirable to locate the trench silo on slopping ground.
- Capacity is depends on size of herd and number of day the silage is fed in a year.
- It is always economical to construct only one trench silo, even if it is quite larger.
- Sidewalls are given generally 33 per cent slope.

Safe and scientific storage – warehousing in India

Bulk storage of produce is done in warehouses. Warehouses are scientific storage structures especially constructed for the protection of the quantity and quality of stored products. The warehouses are owned by FCI, CWC or the SWCs. The Central warehousing corporation (CWC) was established as a statutory body in 1957. The Central Warehousing Corporation provides safe and reliable storage facilities for about 120 agricultural and industrial commodities. It is the largest public warehouse operator in the country. It also offers services in the area of cleaning and forwarding, handling and transportation, procurement and distribution, disinfection services, fumigation services and other ancillary activities ie safety and security, insurance, standardization and documentation.

Separate warehousing corporations were also set up in different States of the Indian Union. The areas of operation of the State Warehousing Corporations (SWCs) are centres of district importance. The total share capital of the State Warehousing Corporations is contributed equally by the concerned State Govt. and the Central Warehousing Corporation. Apart from CWC and SWCs, The Food Corporation of India (FCI) has also

created storage facilities. The Food Corporation of India is the single largest agency which has a capacity of 26.62 million tonnes.

For safe and scientific storage it is important to carefully select the storage site, storage structure, undertake cleaning and fumigation, ensure proper aeration of grains followed by regular inspection of grain stock. Pest infestation in grains is affected by moisture content of grains, relative humidity, temperature, storage structure, storage period, processing, hygienic condition and the fumigation frequency followed.

The major pests of stored grains include beetles , weevils, moth and rodents. The control measures include two types of treatment – prophylactic and curative. The prophylactic treatment involves the use of pesticides like Malathion , DDVP and Deltamethrin (2.5% WP). Curative treatment involves use of fumigant aluminium phosphide to control infested stock or godown in airtight condition. For controlling rodents rat cages, poison baits and use of rat borrow fumigation is recommended.

Steps necessary for good storage practice in respect of all food grains

Stored product pests can be managed either behaviouraly (traps *viz.*, probe traps, light traps, pitfall traps etc.,) or with several preventive and curative measures (both chemical and non-chemical methods). Once a facility is obtained, a number of steps are to be taken to ensure safe storage of grains. These steps comprise,

1. Before storage

- Checking for leakage of rain water and sufficiency of drainage facilities
- Cleanliness of the facility and environment
- Assessment of capacity of the facility
- Pesticidal treatment
- Security and firefighting arrangements and
- Repairs to available equipment

2. After receipt of seed

-Inspection for variety and soundness of quality

- Inspection carefully for infestation, it any, and when present, for type and extent of infestation,
- Inspection whether grain has excess moisture, whether it had been heated up in earlier storage and has any musty or rancid odour
- Any grain rendered wet or damaged to be segregated and salvaged with facilities available and check the weight received

3. During storage

- Maintenance of cleanliness
- Ensuring aeration where necessary
- Checking for leakage after rains
- Inspection for insects, rats and mites at fortnightly intervals
- Watch for advancement in deterioration, if any,
- Pesticidal treatments necessarily based on observations
- Ensuring disposal where called for, and
- Arrangement for segregation, salvage and processing, wherever, damage owing
- to leakage of water and other causes might have taken place.

CONCLUSION

The grain production has been on the rise with better facilities in terms of seeds, technology, fertilizers, pesticides and irrigation but associated is the loss of grains which has also increased. Around Rs 50,000 crores every year are lost due to improper storage of food grains. Natural contamination of food grains is greatly influenced by environmental factors such as type of storage structure, temperature, pH, moisture, *etc*. At any given time 60-70% of grains is stored on the farm in traditional structures like Kanaja, Kothi, Sanduka, earthern pots, Gummi and Kacheri. However indigenous storage structures are not suitable for storing grains for very long periods.

Here in lies the significance of improved storage structures and scientific storage of grains in form of warehouses. These provide safe and economical means of grain storage for long durations. Need of the hour is to strengthen traditional means of storage with modern inputs and to provide cheaper storage to farmers so as prevent enormous storage losses.

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