

STORAGE STRUCTURES FOR SAFE STORAGE OF GRAINS



Introduction

- To cope with the current and future demand of the increasing population for the food grains, it is emphasized to reduce the loss of seeds during and after harvest.
- Seeds are stored for varying periods to ensure proper and balanced public distribution throughout the year.
- Post-harvest losses in India are estimated to be around **10 per cent**, of which the losses during storage alone are estimated to be **6.58 per cent**.

Best storage performance

1. The produce must be thoroughly cleaned and graded.
2. Dried to the safe storage moisture level of **10-12 % for cereals** and **7-9% for oilseeds** (on wet basis) for a safe storage period of **6-12 months**.
3. Storage structures should to be properly repaired, cleaned and disinfected.
4. Structures should bear the load of seeds stored and do not permit contact/ exchange with outside humid air.
5. Structures should be constructed in the coolest part of the house/ farm.

Ideal storage facility should satisfy the following requirements

1. It should provide maximum possible protection from ground moisture, rain, insect pests, moulds, rodents, birds, fire etc.,
2. It should provide the necessary facility for inspection, disinfection, loading, unloading, cleaning and reconditioning.
3. It should protect grain from excessive moisture and temperature favourable to both insect and mould development.
4. It should be economical and suitable for a particular situation.

STORAGE STRUCTURES

Different types storage structures

1. Conventional storage structures
2. Improved rural - level storage structures
3. Community storage structures

Conventional storage structures

Structures	Make	Stored items	Capacity	Remarks
1. Bamboo structures	Split bamboo woven in the form of a cylinder with wide base and narrow mouth	Paddy, wheat and sorghum	500 kg	Life 4-5 years. Weight loss due to insect attack is 5 % in paddy and 15% in sorghum.
2. Mud and earthen structures	Clay, straw and cow dung- 3:3:1. Earthen structures are made, sun dried and then burnt in fire	Paddy, wheat, sorghum,oil seeds and pulses	5 to 10 q	Life 8- 10 years. During rainy season develop cracks and moisture absorption followed by insect and mould infestation.



Bamboo structures



Mud and earthen structures

3. Wooden structures	Local wood is painted black. At the top, 30 cm x 20 cm in let and at the bottom 30 cm x15cm outlet is provided.	Paddy	10 q	15- 20 years. Neither airtight nor moisture proof.
4. Brick structures	Rectangular, structures built as part of the house, with brick in cement or lime mortar having a wall thickness of 40 –50 cm. At the top 50x 50 cm inlet and at bottom 15 x15cm outlet is provided.	Paddy, sorghum and wheat	25- 30 q	25- 30 years. High initial cost, not insect and moisture proof.



Wooden structures



Brick structures

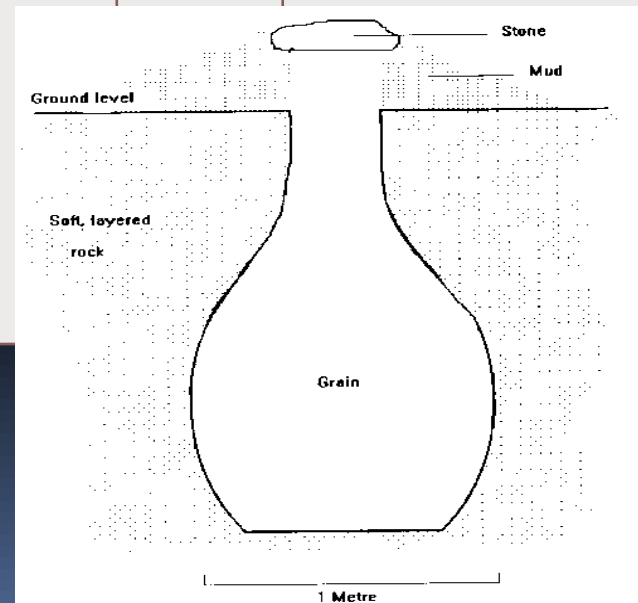
5. Underground structures

Circular pits vary from 100–400cm in depth and 50 – 100 cm dia at neck and 250 – 300 cm at the bottom. For filling and emptying there is an opening at the top. Before filling the sides and bottom are packed with straw and husk. After filling the pit is again covered with straw and stone, the finally with mud.

Cereals

100 – 200 q

Safe against insects but, loss of seed viability and handling difficulties made it out of date.



Drawn by D L Proctor, after Hall *et al* (1956)

<p>6. Miscellaneous plant materials</p> <p>a. Paddy straw</p> <p>b. Stem of vitex and pigeon pea stalks</p> <p>c. Bottle gourd shells</p>	<p>a. paddy straw is wound in the form of rope to varying diameter</p> <p>b. stems wound like a bin and both sides are plastered with mud and cow dung</p> <p>c. empty shells are used</p>	<p>Paddy, other cereals and pulses</p> <p>Paddy and other cereals</p> <p>Pulses, gourd seeds</p>	<p>30–100q</p> <p>1-2 q</p> <p>2-5 kg</p>	<p>Not insect and rat proof</p> <p>Temporary</p> <p>Only small quantity of seed lots.</p>
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<p>7. Metal corrugated G.I. sheets</p>	<p>Sheets of about 3 m high are held vertically along one edge and edges of the other sheets are overlapped and bolted to each other. Thus the circle with 2-4 m dia. It is completed with many such sheets. They are covered on the top with the plain M.S. or G.I. sheets.</p>	<p>Various types of seeds</p>	<p>Vary</p>	<p>Vary Temporary</p>
<p>8. Hessian cloth bags</p>				
<p>9. Gunny bags</p>				

IMPROVED RURAL - LEVEL STORAGE STRUCTURES

- 1) Bitumen/ coal tar drum
- 2) Hapur bin/ Kothis
- 3) Udaipur bin
- 4) Stone bin
- 5) Bamboo bin
- 6) Baked clay bin
- 7) PKV bin
- 8) The "Pusa" bin.
- 9) Pusa Cubicle
- 10) Pusa Kothar
- 11) Metal bins

1. Bitumen/ coal tar drum

- An alternate model of metal bin, low cost with similar technical performance.
- These bins are of 520 mm dia and 900 mm height. They can store **1.5 q of wheat and 1.2q of Bengal gram.**
- It was developed at the **Central Institute of Agricultural Engineering (CIAE)** and compares very well with other metal structures.



2. Hapur bin/ Kothis

- The Indian Grain Storage Institute, which is engaged in the development and dissemination of advances in storage technology to users, has developed metal bins for domestic storage of food grains
- Circular bins of 2, 5, 7.2 and **200-100kg (10 q) capacities** and have potential to meet requirements of even large farmers.



3. Udaipur bin

- These bins are made out of used coal tar drums.
- These can stock **1.3 q of wheat and maize.**
- These bins can be made to have more airtight lid if the drum outlet end is given small cut to unload the bitumen.
- These bins are suitable for storing of food grains for short duration and can be adopted by small farmers.

4. Stone bin

- Stone bin (Chittore bin) is made of locally available 40 mm thick stone slabs with dimensions of 680 mm x 1200 mm with square cross-section.
- The inlet and outlet are made of asbestos. This bin has a **capacity of 3.8 q.**

5. Bamboo bin

- These bins are made of two walls of bamboo with polythene lining in between and have varying capacities.
- These bins are suitable for short – duration storage and can be adopted by small and marginal farmers.

6. Baked clay bin

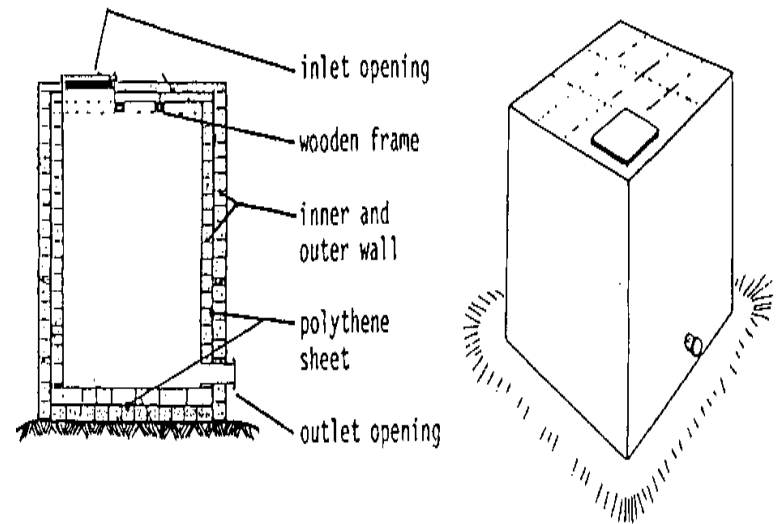
- Baked clay bin of **7q capacity (paddy)** is made of 16 burnt rings jointed by mud plaster; cement mortar and cow dung coatings one after another.
- The ends of the rings are made in such a manner that they fit into each other.
- These rings are kept on a polythene sheet covered and plastered platform of brick masonry and cement sand mortar.
- An outlet is provided for the discharge of the grain.
- The top is covered with a mild steel lid. Because of the low cost and good performance these are particularly useful for small and marginal farmers.
- Do not store their produce for longer duration.

7. PKV bin

- Made from **green bamboo** splits into suitable sizes.
- The tunnel, outlet flap valve and complete stand can be fabricated in a workshop.

8. The Pusa bin

- Developed by the **Indian Agricultural Research Institute (I.A.R.I.)**; they are rectangular in shape and have a **capacity of 1 to 3 tonnes**.
- The "Pusa" bin has been widely adopted in India, and has been demonstrated in some African countries. It gives good results when loaded with well dried grain



Source: Bodholt and Diop (1987)

9. Pusa Cubicle

- This is a room like structure (3.95 x 3.15 x 2.60 m), a modification of Pusa bin to provide large storage **capacity of 24 tonnes** on a platform of 3.73 m x 2.93 m x 0.07 m is made with unburnt bricks on a concrete floor (except 22 cm of outer sides with burnt bricks).
- A polyethylene sheet is placed on this platform and another platform of similar dimension is made with unburnt bricks.
- The 22 cm thick inner walls are constructed upto 2.6 m height. A wooden frame of 1.89m x 1.06 m for door is fixed in the front side of 3.95 m wall.
- The roof can be made by wooden beam placed at 15 cm distance and covered with unburnt bricks.

10. Pusa Kothar

- Presently storage is practiced in small compartments of a room (5.3 m x 2 m x 4 m) called kothar.
- The roof is constructed with the help of wooden poles and mud slabs, leaving near the front wall three filling holes each of 0.5 m x 0.5 m size.
- Two outlets of G.I. sheets of 15 cm dia. and 30 cm length are fitted at the floor wall on the front side.

11. Metal bins

- Bins made of steel, Aluminium R.C.C are used for storage of grains outside the house.
- These bins are fire and moisture proof.
- The bins have long durability and produced on commercial scale.
- The **capacity ranges from 1 to 10 tonnes**. Silos are huge bins made with steel/ aluminium or concrete.
- Usually steel and aluminium bins are circular in shape.
- The capacity of silo ranges from **500 to 4000 tonnes**. A silo has facilities for loading and unloading grains.



COMMUNITY STORAGE STRUCTURES

- Bulk storage structures of higher capacity, ranging from **25-100 t** are termed community storage structures (Birewar 1985).
- They are made from reinforced bricks, corrugated galvanised sheets and aluminium sheets in capacities ranging from **25 to 57 t**.

ALTERNATIVE STORAGE TECHNOLOGY AT FARM/VILLAGE LEVEL

Metal or Plastic Drums

- Drums are often used as storage containers in the house and serve notably for the **storage of cereal seeds and pulses.**
- Plastic drums are used intact or after having the upper part cut off to facilitate loading and unloading. Otherwise, plastic lends itself poorly to adaptation because it is relatively weak: at most, a lockable outlet can be added. If the lid is tight fitting and the drum is completely filled with grain, any insects present will deplete the oxygen in the drum and die.

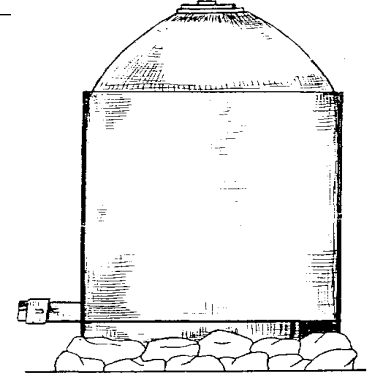


- Metal drums can be adapted for domestic grain storage in a similar way. A removable lid permits easy loading; but it is also possible to weld half of the lid to the rim of the drum, and provide a riveted hinge on the remaining half of the lid so that it alone can be opened.
- Fitted with a padlock, such a modified drum is more secure. To make a store of greater capacity, two metal drums can be welded together end to end and fitted out as described above. Well modified and/or fitted with gaskets, metal drums can also be made airtight.

- Inaccessible to rodents, efficient against insects, sealed against entry of water, drums make excellent grain containers. However, they should be protected from direct sunshine and other sources of heat to avoid condensation by being located in shaded and well ventilated places.

Alternative Solid Wall Bins

(i) The "Burkinò" silo



Source: Bodholt and Diop (1987)

- Based on a traditional dome shaped type of bin, this silo is constructed with stabilised earth bricks. Various models and capacities are available.
- The base is made of stabilised earth resting on the ground or on concrete pillars. The dome-shaped roof is also made of stabilised earth bricks, using special wooden formers. The technique of making a dome-shaped roof is not easy to master, and usually has to be done by skilled masons. A variant has been developed with the roof resting upon a wooden frame, which can be erected by unskilled farmers

(ii) The "USAID" silo

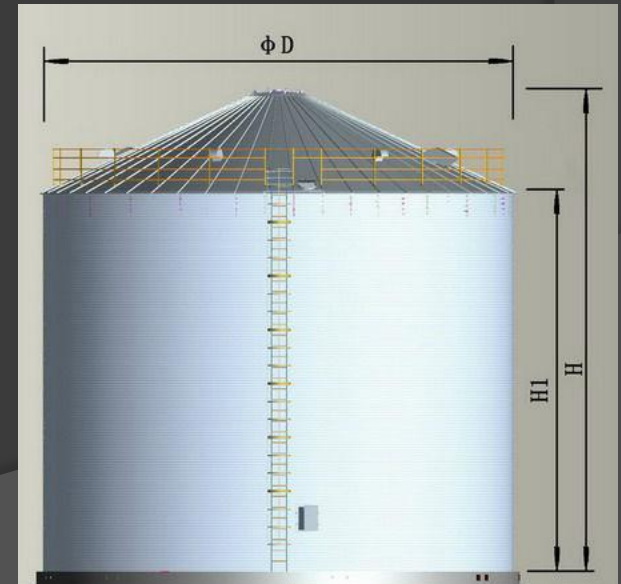
- This silo is based on the "Burkino" silo and examples have been erected in Nigeria; holding **one tonne of maize grain**, the silo rests on stone or concrete pillars supporting a reinforced concrete slab 1.5 metres in diameter. The walls are made of stabilised earth bricks and are plastered inside and out with cement reinforced with chicken wire mesh. The top is dome shaped with a central round opening, and covered with a cone-shaped earthen cap. This is plastered with cement, and rests on bamboos or on a metallic drum base. An outlet door, consisting of a 15 x 30 cm plate 1.5 mm thick which is smeared with grease for easy sliding, is let into the base concrete slab.

(iii) Concrete/cement silos

- Such silos are 'cement rich', and often include other materials which normally have to be imported into developing countries. Therefore they are potentially (and usually) expensive structures, which can be seriously considered only when improvements to traditional storage bins cannot be practically applied. Their redeeming feature, given that they are properly constructed and used, is that they are robust and should give many years of satisfactory service.

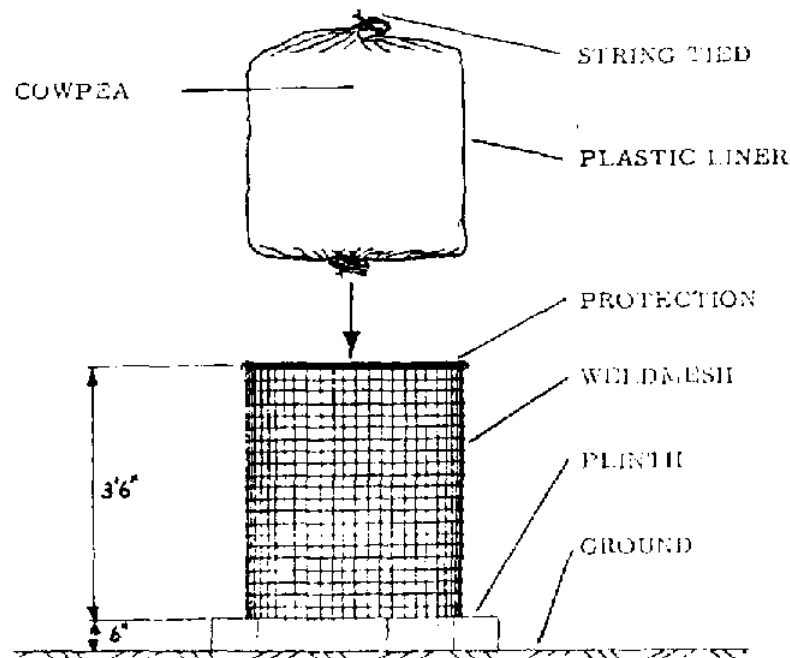
(v) Metal Silos

- Economically valid for storing large quantities (over 25 tonnes), metal silos are often regarded as too costly for small scale storage. Nevertheless certain projects have been successful in introducing small metal silos, of **0.4 to 10 tonne capacity**, at farm/village level in developing countries.



(vi) Synthetic Silos

- Various attempts have been made to develop small scale storage bins, using synthetic materials such as butyl rubber (O'Dowd, 1971) and high density polyethylene (CFTRI, 1975).
- However, such bins proved to be either too expensive or prone to damage by pests. Also the management level required by such storage facilities is probably too high for most rural situations.



Source: O'Dowd (1971)

CONCLUSION

- Traditional storage structures need to be improved scientifically.
- Intensive research is required to evolve modern storage structures suitable to different agro-climatic conditions of India.
- State and central government agencies should possess temporary storage structures to handle bulk grains without any loss and damage.



THANK YOU