METHOD OF STORAGE

1. History of storage

Storage is an ancient process of preserving goods, since goods were not produced regularly at the place of consumption when required. They were stored from the time of production till they were wanted by the consumer. Storing had its faint beginning with the very dawn of civilisation and despite of scanty specific evidence, storage reserve supplies probably existed with prehistoric men. Storage is an exercise of human skill by which commodities are protected from deterioration and surplus is carried over for future consumption during the period of scarcity. Most of the agricultural goods produced are seasonal in nature and are not consumed immediately but are consumed future. Hence, they year required to store for a longer duration.

Type of storage

Foodgrain is purely metabolic order are of different life span, which needs to be stored for a particular period of time i.e. on their longevity and decay factor which can be classified into two different categories first such as fresh fruit, vegetables, dairy products, meat etc. which have fast metabolism and easy to reach external factors and secondly those of which have a slower metabolic sense and resist the external factors at varying degree more than the farmer food products and this type of storage for different categories of products will also be differ. In general, two types of storage systems are in practice.

(a) Refrigerated storage –

The food for which low temperature are essential or desirable in storage include their products such as fresh fruits, vegetables, dairy products and meat. These products have sharp metabolic reaction to the external factors require refrigeration, such products have no cause of alarm from insects. Only fungi and moulds do cause harm which can easily be controlled through low temperature. Merely insects are not a problem in this type of storage. In general control of moulds and fungi is affected by storage at low temperatures and by methods of sanitation which infection. The first requirement of fruit and vegetable storage is that it should be constructed and equipped to permit continuous temperature
control. The optimum temperature for storage of various products extend over a wide range. Adequate insulation, adequate refrigerating equipment and enough provision for air circulation are essential requirements in any temperature controlled storage. Danger of mould infection is reduced by having interior walls and floor smooth for easy cleaning where rodent control is a problem. Masonary buildings can be constructed to exclude invasion by rats and mice. In such cases it is essential to have all points entrance sealed. A single small hole in the masonry structure may be source of serious rat infestation.

(b) Non-refrigerated storage

The other type of food products which have slower metabolic activity and resist the external factors to some degrees are stored through this type of storage system. The main enemies of such products are insects, rodents, moulds and fungi. The farmer of a poor country like India, with their scant resources can not provide for such kind of storage structures required to contain the aforesaid decaying factors since storage places are the part of their living structures in which due to a variety of reasons there are enough breeding grounds for these decaying factors to grow. Due to improper door closing system, the unplastered and in many cases cracked walls, even kutcha houses and a number of other small passages which can not be easily sealed with the result of which the rodents as well as crawling insects have easy passages, favorable conditions for bacteriological infectious to grow. Thus, these factors cannot entirely be checked but growth can be reduced/checked to some extent by observing certain measures and creating conditions which can be elaborated in the following manner.

(i) The moisture content in grain is the single most agent which is favourable growth of moulds, fungi and insects resultant infestation to store grain. The moisture content in the stored grain emits water vapour in dry atmospheric climate which cause vicinity in the commodity and as much cause damaging of grain. Therefore, to control these factors, grain stored should be well dried up.

(ii) To check storage place being a growing grounds for insects as well as bacteria grain should be thoroughly cleaned.
(iii) The insects as well as bacterial growth is accelerated in the rainy season due to relative humidity resultant absorption of moisture content by the stored grain in favourable temperature. Therefore, such prophylactic measure as pre-monsoon fumigation and curative measure if insect growth observed, is necessary.

(iv) The occasional learning and sweeping of storage structures over a period of time keeps away the menace of insect growth in its various farms from egg to adult and also sweepage so collected should either be thrown far away from the storage point or dumped in the ground.

(v) The quality masonary construction as well as effective sealing of all passages/cracks of storage structures can effectively check the rodents/crawling insect menace.

(vi) Timely inspection atleast once in twenty one days of the grain stored is necessary. Usually the life cycle of insect is completed within the said period. In rainy season emphasise is laid on frequent inspection of entire storage structure to eliminate chance of rain water seepage/leakage in structure which may cause damage. Any type of damage to grain is noticed in any inspection, immediate measures should be contemplated.

Method of storage

The most common food of Indian people are wheat and rice which are stored in different ways. Mainly the farmer retains a some part of production to sell at better price also for home consumption, seeds and other purposes too. Similarly Food Corporation of India stores wheat for distributing to defence and State Governments at cheaper rate. It also acts to check higher prices in the market. Therefore, storage of wheat and rice is important for our country. This chapter deals with the method of storage in practice at various level viz. Government/Semi-Government and at farmer level. It is classified into two categories.

1. Scientific storage method

2. Traditional storage method

Holding and preservation of stocks stored to maintain the quality synchronous to time lag and to keep it at a particular level during various
operations such as loading/unloading of stocks and upkeep the stocks stored hygienically sound for a length of time till its liquidation is known as scientific method of storage which may either in bags or in bulk. This method of storage is in general practiced by Government/Semi-government, warehouses which have enough infrastructural facility available and various co-ordinating factors viz. trained personals with adequate scientific know-how and regular inputs availability and a network of godowns. This method of storage can either be in bags or in bulk.

A. Bag Method

This method of storage of wheat is filled in jute bags in view of the fact that wheat is a living organism requiring respiration which is not possible in polythine bags. After filling wheat in bags and the mouth of bag is stitched and stencilled to mark the marketing year then bags are stored in godowns in block pitched to a scientific height so that easy counting of bags could be possible. These godown are manufactured on a raised platform of 3 to 4 in a height to ensure non-proliferation of rodents and adequate length and width to economies on cost with the bags stored upto to certain height and provide if with a kind of roofing and ventilators as to ensure freedom from moisture, insects and adequate airation, Moreover, the block formation is typical of a certain prescription in which the bags are pitched from block to make a stake which has a certain number of bags again and in uniform in nature. The stacks are so formed as to keep specifically ways to the entire length of a particular unit and galleries before doors to ensure easy preservation and other related operations. These galleries and ally ways also help in periodic inspection/treatment of stocks stored in godown.

B. Bulk Method

This is one of the form of storing of surplus grain in yet improved structures of storage designated with latest technologically know-how by using steel reinforced concrete in different size. The bins traditionally used have been with improvised reform built in certain capacity in different shape and size on having fitted with mechanized grain lifting devices the elevator silos. There are three types of improved bulk storage methods in use.
a. Hexagonal Bins

In the recent years standard famous concrete hexagonal bins with main hole at top and spout at the bottom constructed in different size.

b. Circular Bins

Using the same material and principle used in hexagonal bins, the circular over ground bins are built which can be put in pair and row with grains discharged from opposite side.

c. Elevator Silos

On the basis of shape and principle used in bins the big structure of circular, square, hexagonal, optagonal, flopper bottom, flat bottom, deep and shallow ‘BUNJURE’ are constructed in various capacities provided with mechanical grain filling, storing devices. This has revolutionised the system scientific storage throughout the world to keep the grain hygienically safe for a period of time with proven immunity from various loss causing agents.

The advanced form of bulk storage in silos keep the grain free from insect, moisture even caused by atmospheric humidity during monsoon period, rodent damage, low cost treatment if deterioration from any particular loss is perceptible and do economics in cost of gunny bags due to re-use of gunny bags dunnage martial. The biggest loss causing agent in this form of storage is moisture penetrated in the structure either due to cracks. Form the walls of the structures or grain stored at the time of filling beyond tolerance limit may cause serious damage to store grain. Therefore, if a qualitative safe guard can be observed in construction of silos and permissible standard of grain filling up to a particular level of moisture can be ensured, this can prove best scientific method with all advantageous effect of a proven technology.

2. Traditional storage method

Since time of your mankind has invented methods to save grain from deteriorating factors which are called traditional method of storage. The traditional method of storage are too much such as cellars, granaries, bukhari, kuthila, open under roof, theka, adda, under straw heap etc. practised different times and some of them are continued to be practices even now. These methods were advantageous
The most common methods which are used by the farmers to store wheat in India are elaborated in the fashion.

**B. Bulk Method**

In this method a convenient room of the house is selected for wheat (or any other such grain). The loose wheat is stored in the room. This method is mostly used by the large farmers who expect to have more quantity of wheat and cannot afford to buy gunny bags or other kind of costly structures.

**Merits of Bulk Method**

This method has following merits.

i. Wheat can be stored in huge quantity.

ii. A convenient room can easily be selected with easy approaches.

iii. It is easy to construct it and has multipurpose advantages which can be utilised as living room after liquidation of stored grain.

iv. Storing of grain as well as liquidation is easy involving low cost, demerits.

Following are the main merits of the method.

i. In the method, the losses are more as compared to other method of storage.

ii. This method is not a modern method of storage and is very much susceptible to humidity.
b. Bag Method

Most of the farmers retain their commodities in bags and mostly this type of method is used for storing wheat. After filling the grain in gunny bags and pack it by proper stitching and put it either in a room of a verandah spreading a thin layer of straw to prevent dampness. Later the bags are stacked one upon other so that they occupy less space.

Merits

(i) It is easy to handle and direct loading that is convenient and can be carried from one place to another place due to perfect mobility.

(ii) The grain can be stored safely for a longer period of time.

(iii) The inspection of stocks is frequently possible and equally easy for curative treatment.

(iv) Losses occurs very scarcely in comparison to other methods.

Demerits

(i) The gunny bags being a costly input with a short life span proved expensive on cost factor.

(ii) The structure employed in this method are neither moisture or insect proof nor rodent protected as such frequent inspection and treatment is warranted envolving cost.

3- Kuthila Method

Kuthilas are sort of home made silos and are made up of mud, chaff and animal dung. They are constructed in parts and their construction process is rather slow. After one part is constructed and dried the other part is superimposed upon it. The silo is conical in shape with the base about a meter is diameter and about one and half meter in height. Its capacity is about one and half tonne of grain. This method is mostly used by small farmers. This method is very much susceptible to moisture.

Merits

(i) It is relatively less expensive and can be constructed by family members in leisure time.
(ii) It covers little space.

(iii) Small size kuthila can be freely moved from one place to another at farmers own convenience.

Demerits

(i) Heavy losses occur due to moisture in this method.

(ii) This method is not suitable for storing huge quantities of grain for longer period.

(iii) Quality of commodity deteriorates gradually.

3. Steel Bins Storage Method

Steel bins are improved method from kuthilas. It is more scientific and safe method of storage. Steel bins are made of steel sheets turned in round shape providing a covered mouth of upper side for filling grain and one outlet in bottom to take out of the grain. These bins are moisture, rodents to some extent pest proof. The capacity of such bins ranges from 5 to 15 quintals. Due to more scientific method of storage, the Government agencies like U.P. Agro-Industrial Corporation first supplied these bins to the marginal farmers at subsidised rate to make it more popular.

Merits

(i) Steel bins are easy to transport.

(ii) It can be kept at a convenient place in the house.

(iii) This structure is moisture, rodents, birds and to some extent pest proof.

(iv) Timely inspection, prophylactic and curative treatment can be administered whenever required.

Demerits

(i) This method employs for storing of lesser quantity of wheat as such hence it is not suitable for middle as well as big farmers.

(ii) Steel bins are economic even than marginal/small farmers can not purchase these bins at subsidised rate.
5- **Loose covered with straw**

This method entails the sandwiching of a layer of foodgrains as thick as desired or possible in a given structure between straw spread on the surface covered by a piece of cloth or used gunny bags and tap again apply the same material than stitched together spread on the surface of stored grain and again a thick layer of straw spread over the foodgrain. This method keeps the effect of dampness at bay keeping the quality of grain sound to a maximum extent.

**Merits**

(i) Effect of moisture/dampness is relatively low due to high temperature of straw.

(ii) The quality of grain in this method is uniformly maintained.

(iii) The layer of straw acts as a permanent shield against transmission of heat thus uniform temperature of stored grain is maintained.

(iv) This method proved relatively cheaper as straw is one of the by products of crop available in plenty with the farmer.

**Demerits**

(i) Probability of fire hazards is inherent in such type of method as the straw catches fire easily causing substantial damage to store grain.

(ii) Periodical inspection of grain is not possible. Therefore, there is any infection noticed preventive/curative measures can not be administered whenever needed.

(iii) This method is also proved counter productive when the structure used as storage point is kutcha muddy house in which moisture during rainy season can seep through walls and affect the grain comes in contact resultant damage.

6. **Adda Storage Method**

This method also being a traditional method and resembling the former one in more ways than one. Again in the same compulsion to save investment on gunny bags required in large number. In this method gunny bags full of grain are stacked in the stem portion of the adda to a certain height and in the interior portion of thick
layer of straw covered with clot/gunny pieces stitched together. The loose grain is stored in side walls hay sticks are bundled together as dunnage material.

**Merits**

(i) This method is particularly useful for the farmers having little accommodation for their living by dividing room in a adda and rest of the space use for residing.

(ii) It is relatively cheap and large quantity of grain can be stored in this method.

(iii) This method is less expensive because it is practised by using farm by products such as straw, hay sticles and few old gunny bags.

**Demerits**

(i) The outer most side of gunny bags stored in vulnerable to growth of micro-organisms by virtue of its being without any particular shield.

(ii) Proper treatment whenever needed can not be administered.

(iii) Stored grain is open to rodent hazard as there is no barrier to keep them off from stored grain.

(iv) Stored grain may absorb moisture from the seepage from constructed portion or from saturated air precisely the part of which is in its direct contact.

**7. Pucca Kothi Storage Method**

This is the improved method of storage and is advanced from of Kuthilas or home made silos. It is made of bricks and cement and in rectangular shape. An isolated or safe place in corner of room or verandah is selected to install of such structure. These are made on 9” to 1.5” raised plateform. The bricks are placed in the criss crossed manner upto a desired height and on the top of it well cutout opening is provided to fill up grain through it and in bottom another hole is made to take grain out (out let.)

**Merits**

(i) It occupies relatively little space.
(ii) Being a home made storage structure a convenient size is made.

(iii) Pucca kothi may be treated with pesticides or with smoke of Neem leaves without any harm to structure.

(iv) It is easy to handle.

(v) Effect of moisture/dampness is relatively low due to made of bricks with cement mortar work as a barrier.

(vi) The quality of grain stored in this method is maintained.

(vii) Grain may be stored for longer period.

(viii) Timely inspection, prophylactic and curative measures can be administered whenever required.

Demerits

(i) It is not suitable for storing huge quantity of grain.

(ii) Economically marginal or small farmers can not installed pucca kothi as they can not afford the construction cost.

8. Khatti Storage Method

It is kind of pit storage. A pit is dug into the ground and foodgrains are stored therein. This called khatti method of storage. This method of storage is not so important for the farmers as it is in the market. These pits vary in capacity from 80 to 300 quintals according to the requirement.

Merits

(i) Huge quantities of grain can be stored without sacrifice of floor space.

(ii) Ground space can be utilised properly.

Demerits

(i) This method is very much susceptible to moisture, rats etc.

(ii) Losses are very high in this method.

(iii) It is too costly at village level.
2. Ferro-Cement Storage Bin

The structural Engineering Research Centre Roorkee has designed a simple ferrow-cement storage bin which could help farmers to store their grain without loss. The small ferro-cement bins developed by the Centre can store up grain to the extent of three tonnes. A bigger type can store upto ten tonnes. To cater the needs of small farmers, the centre is also developing one tonne and half tonne capacity bins. These bins can be placed above ground or under ground without affecting the stored commodity.

Merits

(i) It is very handy.

(ii) It is more scientific and losses are minimised.

(iii) It is more durable.

(iv) It cant be placed any where in the house and possibility is there that the aerial space of above bin can be utilised.

Demerits

Only demerit of this method is that it is costly.

3. The Method in Use

In our study only first four methods i.e. bulk, bag, steel bin and kuthila were used by the farmers at the village level under traditional method of storage. The following table shows the position of cultivators in different methods in different periods on various farm size groups between users and non-users of insecticides.

4. Use of Insecticides by the farmers

The evidence of loss is usually higher in case of farmers who did not use the insecticides/pesticides than those who used them. The use of insecticides in the villages is not uniform. In the present study Table 4.1 indicates the extent of use denoted by the number of farmers using and not using insecticides/pesticides in different methods of storage.¹

¹For detail related to number of farmers and their percentage between users and non-users of insecticides in different methods, in different periods on various farm size groups, See appendix-VII.
Fig. 4.1: Showing number of farmers and their percentage between Users and Non-Users of insecticides under different methods of storage

Scale: 1 cm. = 5 percent

- Users
- Non-users
Table 4.1 Number of farmers and their percentage between users and non-users of insecticides under different methods of storage.

<table>
<thead>
<tr>
<th>Methods of Storage</th>
<th>Users</th>
<th></th>
<th></th>
<th>Non-users</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of farmers</td>
<td>Pc. Of farmers</td>
<td>No. Of farmers</td>
<td>Pc. Of farmers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Bulk</td>
<td>201</td>
<td>32.01</td>
<td>82</td>
<td>13.06</td>
<td></td>
</tr>
<tr>
<td>Bag</td>
<td>167</td>
<td>26.59</td>
<td>83</td>
<td>13.21</td>
<td></td>
</tr>
<tr>
<td>Steel Bin</td>
<td>53</td>
<td>8.44</td>
<td>26</td>
<td>4.14</td>
<td></td>
</tr>
<tr>
<td>Kuthila</td>
<td>10</td>
<td>1.59</td>
<td>6</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>431</td>
<td>68.63</td>
<td>197</td>
<td>31.37</td>
<td></td>
</tr>
</tbody>
</table>

(The actual number of farmers under study was 120 but the number has increased on account use more than one method of storage by a farmer)

Table 4.1 depicts that the overall proportion of farmers between users and non-users of chemicals while storing their wheat in different methods of storage came to 68.63 percent and 31.37 percent respectively. The proportion of users and non-users cultivators in bulk method came to about 32 and 13 percent. It was 26.59 and 13.21 percent in case of bag method of storage between users and non-users of insecticides. In case of steel bins, the proportion of users was 8.44 percent and non-users was 4.14 percent. The proportion of users and non-users of insecticides in kuthila method of storage was 1.59 and 0.96 percent respectively. It can be said that the proportion of users of chemicals was the highest in case of bulk method of storage followed by bag, steel bin and kuthila. However, the actual numbers of farmers are 120 but the number of users and non-users of insecticides differ from the actual number of selected farmers on account using more than one method of storage by different periods on various farm size groups. It can be safely argued that farmers who used the insecticides are more cautious to maintain the quality of grain to some extent. On the contrary the farmers who did not use them due to lack of technical know-how since most of them are illiterate and they also hesitate to use them on health grounds.