NABARD Head Office Mumbai

Model Scheme on Onion Storage Structures

1. Introduction

India is one of the largest producers of onion in the world second only to China, accounting for 16 percent of total area under cultivation in the world and 10 percent of total production. In India, onion is cultivated in 0.39 million hectares with production of 4.30 million tonnes per annum (FAO,1995). The current year's (2013-14) production is estimated at 4.7 million tonnes. Most of the onion produced in India comes from the state of Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Bihar, Gujarat and Haryana.

Lack of adequate and appropriate storage facility is one the major constraint which enforces distress sale on farmers. The present storage capacities are either inadequate or unscientific. As a result of glut situation the price variability has been too high in the recent past. To improve the situation, GOI desired to create appropriate storage structures for onion, both at farm level as well as at market places. It drew a capital subsidy programme for the infrastructure development in which NABARD has been playing a pivotal role. It has been planned to create a storage capacity of 4.5 lakh tonnes of onion during 1999-2000 and 2000-2001 through capital investment subsidy programme. Subsidy to the extent of 25% of the investment cost subject to a maximum of ₹500 per tonne has been proposed to be routed through NABARD for the credit delivery system.

2. Status of Onion Storage Structures and its Potential in India

The present storage capacity for onion is about 4.6 lakh tonnes. This is quite inadequate compared to our total production. Even most of the structures available are traditional and unscientific. If 40 % of the stocks are earmarked for scientific storage the potential for new storage structures is about 12.6 lakh tonnes. However, it has been projected by the Expert Committee on Cold Storage and Onion Storage that about 1.5 lakh tonnes on-farm capacity in production areas and 3.0 lakh tonnes capacity at APMCs and other market places are required in next 5 years. Thus there remains a vast potential to be tapped.

3. Extent of Storage Losses

The onion bulbs are generally stored from May to November for a period of four to six months. However, 50-90 per cent storage losses are recorded depending upon genotype and storage conditions. The total storage losses are comprised of physiological loss in weight (PLW) i.e. moisture loss and shrinkage (30-40%), rotting (20-30%) and sprouting (20-40%). The PLW can be minimized by harvesting at right time, proper curing of onion bulbs and subsequent storage at desired temperature

and humidity conditions. Generally, the rotting losses are at peak in initial months of storage, particularly in June and July, when high temperature coupled with high humidity result the losses. However, proper grading and selection of quality bulbs and good ventilation conditions can reduce the rotting losses. Application of post harvest fungicidal sprays can also reduce the rottings. But this is not a practice in India. Sprouting losses are usually recorded at the end of storage period or when exposed to high temperature of humid air. Noticeable sprouting losses are observed because of storage of poor quality bulbs having less rest and dormant period and also having thick neck. Comparatively, more sprouting losses are recorded in dark red and white onion cultivars than the light red onion cultivars

4. Onion and its Physiology for Storage

Every agricultural commodity is required to be stored properly to prolong the availability with minimum qualitative and quantitative losses. Onion is not an exception. The onion bulb is a natural food store for the plant, but it is a living system undergoing a process of development towards sprouting, and is subject to decay by various disease causing organisms. The objective of storage technology is to maintain the bulbs for as long as possible in an unchanged sound condition with longer shelf life, and allow them to transport and market after removal from store without much losses.

It is necessary to have the knowledge of the physiology of dormancy and epidemiology of storage disease while thinking of long term storage. Systems to provide long dormant condition and suitable condition which is unfavorable for disease development can be engineered using the physical principles of temperature and humidity control. Also in this process economic and technological constraints will have to be looked into. For this, two basic strategies i.e. high temperature dormancy of onion bulbs and maintaining storage temperature at around 300 C need to be exploited.
The physiological and pathological processes that proceed within a store of onion bulbs interact with the physical process of heat and water vapour exchange so as to mutually influence the environment within the store. Main factors which influence onion storage and bring change in the bulbs are summarized as under in sequence:

- With time, sprouting and internal root development proceed.
- Sprouting and internal root development change bulb shape, tension of skins and crack the skins.
- This increases the conductivity of skins to water vapour and ultimately rate of water loss from the bulbs.
- Increase in sprouting increases respiration.
- Increase in respiration increases outputs of heat, CO2 and water loss from the bulb.
- Diseases are developed in store when there are favorable conditions and bulbs thus get deteriorated.
- Bulb deterioration due to diseases will also increase respiratory outputs. The onion skins has vital role in the physical and physiological processes in the

storage, as it is the main barrier to water loss and to CO2 exchange. 65-70% relative humidity is desirable to maintain the skin fairly flexible and elastic. At lower RH, the skin become very brittle and gets easily cracked notably when skin moisture content falls below 20%.

- Ventilation is needed to maintain humidity between 65-70% and lack of this often adversely affects the quality and quantity by increase in water loss and respiration.
- Ventilation is also needed to dissipate heat produced by bulbs.
- With time, requirement of ventilation for the above will also increase.
- Design of store should, therefore, match the requirements.
- High humidity with high temperature favours spread of pathogens within the store.

It is necessary to counter the above changes by proper monitoring of internal environment. Heat and water vapour must be removed or introduced as necessary either by using heating or refrigeration or ventilation or a combination of all the mechanisms depending upon the economics. However, under Indian conditions in onion growing states designs to exploit natural ventilation is most economical.

5. Onion Storage Structure Requirements

For effective long storage of onion the parameters essential to be looked after are the bulb size, choice of cultivars, cultivation practices, time of harvest, field curing, removal of tops, drying, grading, packing, storage conditions (optimum storage range of relative humidity 65% to 70% with the temperature ranging between 25°C to 30°C).

Salient Features of Improved Storage Structures are:

1. Construction of structure on a raised platform to prevent moisture and dampness due to direct contact of bulbs with the soil.
2. Use of Mangalore tile type roof or other suitable materials to prevent built up of high inside temperature.
3. Increased centre height and more slope for better air circulation and preventing humid micro climate inside godown.
4. Providing bottom and side ventilations for free and faster air circulation and to avoid formation of hot and humid pockets between the onion layers.
5. Avoid direct sunlight or rain water falling on onion bulbs to reduce sun scald, fading of colour and quality deterioration.
6. Maintenance of stacking height to avoid pressure bruising.
7. Periodical disinfection of structures and premises to check rottage.
8. Cost effectiveness of structures is based on utilization of locally available material for the construction.

For onion storage, technology may be either with natural ventilation or with forced ventilation. Although cold storage systems are used in certain countries for onion,

this is normally not adopted in India due to poor economics and lack of cold chain facilities required to maintain the quality in the high ambient temperature prevalent in our country. Onion storage in ventilation condition is quite satisfactory when the temperature is maintained between 25oC to 30oC with a relative humidity range of 65% to 70%. This environment reduces the storage losses, which are in the form of physiological loss in weight, rotting and sprouting. The onion storage structure should be oriented in the North - South direction i.e., length facing the East-West direction. The storage of onion will be on raised perforated platform of 0.60 m height with bottom and side ventilations. The ground clearance may be 60 cm with side opening of upto 80%. Height of storage under ventilation storage should be in the range of 90 cm to 150 cm. For a 25 MT storage, the size of onion storage area will be 4.5m X 6.0m. The width of storage may be reduced depending upon the availability of local construction material and ambient condition. The length of storage structure may be increased to suit the requirements of the individual farmers. The minimum overhang of 1.5 m on the windward side and 0.5 m on all other sides should be provided to protect the produce from sunlight and rain. At leeward side, the opening below the platform should be closed to direct the air upward for better ventilation. Where storms/ cyclones are expected, leeward side should not be closed when the windward side is open. During storm there should be a provision to close the windward side. Emphasis should be laid for better area utilization efficiency. The overall dimensions of a 25 MT structure may be 6.5 m X 7.0 m. The dimensions can be adjusted depending upon the capacity and site conditions. The roof of the structures may be either Mangalore tile type or ACC sheets for a single tire arrangement or RCC for two tier systems. In case of Mangalore tiles, proper fixation should be done at the ends to prevent damage by air. If cheaper materials are available which can prevent heat built up at the top of the structure, they can also be used. The foundations should only support the pillars to bear the load of the structure and wind. Continuous half brick thick wall may be provided on the leeward side below the storage platform to serve as a wind barrier. MS angles may be used for the truss and pillars. Half split bamboo sticks supported by MS angle frames may be used for storage of onion. Side walls can also be of chain link (GI wire) type. It has been observed that such structures can be constructed with an investment cost between ₹1500 to ₹2000 per MT. Therefore, adequate care is to be taken for economizing the structures.

6. Onion Storage Practices

Onions are stored either loose or in bags. The beneficiaries may be advised to sort the onions prior to storage and thereafter atleast once in thirty days to take out the rotten/ infected onions in order to avoid further spread of diseases/ losses. Generally, a loss of about 20-30 % is there during a storage season in the form of weight loss of onions which can be controlled with proper care. However, the other types of losses can be controlled to a greater extent if the structure is designed to facilitate maximum natural ventilation through the stored onion and sorting is done at regular intervals.

7. Promoter's Profile

The promoters can be individuals, group of individuals, cooperative societies, proprietary/ partnership concerns and joint sector companies in public or private sector. While formulating a project, complete details of the promoter(s), their experience in the activity and net worth, etc. have to be incorporated.

8. Physical and Financial Outlay

The following physical provisions with their costs are considered for an onion storage godown.

1. Land,
2. Site development including levelling, fencing, drainage, etc.,
3. Construction of onion storage shed as per the principles indicated above,
4. Provision of wooden beams for the floor and bamboo sticks for sides and floors,
5. Provision of poly ethylene sheets/ gunny bags for preventing sunlight or rain falling on onion.
6. Contingency.

With the parameters indicated above, the average cost of an onion storage godown varies from ₹3000 to ₹4000 per MT. The average cost of a 25 tonnes capacity onion storage godown is considered as ₹1.00 lakh and accordingly the economics of the investment has been worked out. The techno-financial parameters adopted for working out the economics of a 25 MT onion storage structure is placed at Annexure-I.

9. Financial Viability

The financial analysis of the investment of a 25 MT capacity onion storage structure has been attempted and is placed at Annexure II. The project has a margin money component of 25% with the rate of interest on term loan as 14%. For this project, the financial indicators of the investment are as under:

1. Net Present Value @ 15% DF = ₹33,000
2. Benefit Cost Ratio @ 15% DF = 1.308 : 1
3. Internal Rate of Return (IRR) = 36.53 %
4. Average Debt Service coverage Ratio = 1.9602 : 1

As per the cashflow statement and repayment schedule given in Annexure III, the term loan can be recovered in 5 years without any grace period.

10. Dos and Don'ts

In order to safeguard the interest of bankers and borrowers, it would be necessary to take certain precautionary measures. As a ready reckoner, some of the important aspects are shown in the form of Dos and Don'ts in Annexure IV for success of the scheme.

11. NABARD's role

NABARD provides refinance support to various eligible financing banks for financing onion storage structures under its normal refinance programme, the guideline for which are issued from time to time. A cheklist to be used by the bankers for submitting the proposal for refinance is given at Annexure V.

Government of India has sanctioned a capital investment subsidy scheme for construction/ modernization/ expansion of cold storages and storages for horticultural produce. The details of the scheme are placed at Annexure VI. NABARD has been made a nodal agency for promoting the activity through credit delivery system.

Annexure I

TECHNO - FINANCIAL PARAMETERS AFDOPTED FOR WORKING OUT THE ECONOMICS OF A 25 MT ONION STORAGE STRUCTURE

1	Land requirement	6.5 m X 7.0 m
2	Storage space requirement	4.5 m X 6.0 m
3	Technology preferred	Natural or forced ventilation maintaining a temperature between 25 and 30 o C with a relative humidity range of 65 to 70 %.
4	Clearance of storage platform from the ground	60 cm
5	Height of the storage platform	90 to 150 cm
6	Cost of construction	₹100000 (unit cost of ₹4000 per MT)
7	Capacity	25 MT
8	Capacity utilization	100%
9	Weight loss in onion upto 3 months	12.50%
10	Onion sold upto 3 months	50%
11	Weight loss in onion from 3rd to 6th month	12.50%
12	Onion sold between 3rd and 6th months	50%
13	Sale price:	
	(a) Sale price of onion sold at the time of harvest	₹15.00 per kg
	(b) Sale price of onion sold upto 3 months	₹22.00 per kg
	(c) Sale price of onion sold between 3rd and 6th months	₹24.00 per kg
14	Handling/ transport/ grading/ sorting charges	₹3.00 per kg
15	Interest loss to the farmer on investment	14%
16	Life of the storage structure	15 years

Annexure II

MODEL BANKABLE PROJECT FOR A 25 MT ONION STORAGE STRUCTUREMODEL BANKABLE PROJECT FOR A 25 MT ONION STORAGE STRUCTURE

CALCULATION OF IRR, BCR, NPW - 25 MT CAPACITY ONION STORAGE STRUCTURE																
	Particulars	**YEAR**														
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	Capital Cost	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Recurring Cost	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
3	Interest loss on 1.00 lakh @ 14 %	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
4	Total Cost	1.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
5	Benefits	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
6	Salvage value considering the rate of depreciation as 10%															0.1
7	Total Benefits	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.35
8	Net Benefits	-0.64	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.46
9	Discounting Factor	15%														
10	NPW @ 15 % DF	1.25														
11	BCR	1.21	: 1													
12	IRR	56.16%														

Annexure III

REPAYMENT SCHEDULE - 25 MT CAPACITY ONION STORAGE STRUCTURE								
OUTLAY = 100000				**Loan/ finance 75 % of the outlay i.e. 75000**				
Sr. No.	**Bank loan outstanding**		**Net Surplus**	**Payment of Interest @ 14 % p.a.**	**Repayment of Principal**	**Total Outgo**	**Net Available**	**DSCR**
	Beginning of the Year	**End of the Year**						
1	75000	60000	36000	10500	15000	25500	10500	1.41
2	60000	45000	36000	8400	15000	23400	12600	1.54
3	45000	30000	36000	6300	15000	21300	14700	1.69
4	30000	15000	36000	4200	15000	19200	16800	1.88
5	15000	0	36000	2100	15000	17100	18900	2.11
	Average DSCR		1.72	: 1				

ANNEXURE IV
DO'S AND DON'TS

Sr. No.	DOS	DON'TS
1	Suitability of site with proper elevation, drainage and linkages by road.	Site in a low lying area with poor road communication must be avoided.
2	Adequate bottom and side natural ventilation facilities should be provided.	Any obstruction to the natural ventilation should be avoided or minimized.
3	No tall structures should be located nearer to the onion sheds.	Tall structures within a distance of 1.5 times the height of onion storage structures should be avoided.
4	For natural ventilation, storage width should be restricted to 610 cm. In the areas having high humidity, the storage width may be reduced/ necessary mechanical ventilation provision may be made.	Wider storage structures should be avoided.
5	Onion storage structures should be oriented to face wind ward direction.	Structures along the wind direction should be avoided.
6	Leeward side wall opening below the platform should be closed.	Where storms and cyclones are expected, leeward side should not be closed when windward side is open.
7	During storm/ heavy rains, provision should be made to close the windward side and wherever necessary to open the leeward side.	During storm/ heavy rains, windward side should not be kept open.
8	Adequate overhang should be provided to prevent splashing of rain water or sunlight falling on the onion	Structures with small overhangs should be avoided.
9	The roof of material should prevent heat built-up at the top of the structure.	Roof materials like corrugated GI sheets should be avoided.

Annexure- V

CHECK - LIST FOR ONION STORAGE GODOWNS

A) General Information

1. Name, location and office address of the Onion storage unit.
2. Population of the area, crops being grown, land holding pattern, area under irrigation.
3. Production of onions in the area.
4. Names of the financing bank(s) / branch(es) and whether the scheme is in their service area.
5. Approval of the scheme/constructions from the competent authority

B) The Project

1. Objectives of the project.
2. Capacity of the project and justification thereof

C) Promoters

1. Status of the promoters/ company - whether individual/ society/ partnership firm/private limited company/ public limited company.
2. Background of the promoters - educational/ technical/ agricultural/ business.
3. Financial health of the promoter.
4. Other activities being taken up/ planned

D) Technical Aspects

1. Availability of the commodity in the area.
2. Demand of the commodity in the area.
3. Price during harvest season for good storable onion.
4. Price normally rule after three months and six months.
5. Capacity and Location:
   - Locational advantage of the unit.
   - Distance from the main market for the commodity.
   - Location of the nearest onion storage godown from the proposed site & its capacity.
   - Details about the site - Area of the plot/ Site plan indicating the existing roads and the natural drainage.
   - Copy of the land records clearly indicating the title and cost.
   - Other communication facilities available near the site.
   - Any other consideration for selection of proposed site
6. Civil Structures:
   - Items proposed under site development and their detailed specifications (storm water drainage systems, roads, boundary walls, quantum of earthwork, gates etc.)
   - Details of structure clearly indicating the size (L/B/H) and justification for the size.

Layout plan for the proposed structures indicating existing structures, if any.
Ambient temperature and humidity conditions during storage season.
Detailed technical & structural drawings indicating specifications.
Quantity and rate analysis of building materials vis-a- vis rates as per SOR.
Mechanical ventilation provision if any, If so the details with provision of electricity.
Any other relevant information

E) Marketing

1. Arrangement for procurement of the commodity for storage.
2. Services proposed to be offered by the unit.
3. Existing rates of different services.
4. Capacity utilization proposed and justification for the same.

F) Organizational Set-up

Organization Structure , details of manpower requirement and salary structure.

G) Financial Information Project Outlay

1. Item wise cost proposed under site development.
2. Item wise cost proposed under Civil structures.
3. Cost of miscellaneous items if any.
4. Means of Finance: Total Outlay Margin Money Loan Requirement
5. Lending terms:
   Rate of interest, grace period, repayment period, down payment, nature of security, availability of government guarantee for bank loan/ refinance, sources and extent of availability of subsidy etc.
   Proposed schedule of implementation.
   Estimates of aggregate income, expenditure and surplus from the storage.
   Comments on the financial viability of the project along with cash flow, B/C ratio, net present worth, financial rate of return , Internal rate of return and Debt Service Coverage Ratio
   Assumptions made for calculating income and expenditure statement.
   Projected Income and Expenditure Statement for next five years.
   Sensitivity Analysis.
   Socio-economic benefits including employment generation and benefits to farmers.
   Comments on the financial position of the borrowers/ implementing agency.
   In case of companies, partnership firm or society an analysis of their financial position and audited financial statements for last three years.
6. Infrastructure available for project implementation.
7. SWOT Analysis.