

Comparative Economics of Rabi Onion Storage Structures in Ahmednagar District of Maharashtra

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Abstract:- The present study was undertaken with the aim of examining economics of different types of storage structures, evaluate storage losses, assessing the profitability of storing onions, and storage efficiency of onion storages structures. The investigation encompassed six villages, with three located in Akole and Sangamner tehsils of the Ahmednagar district. In the study area, farmers mainly used three different types of structures for storing onions, which were classified into the following three categories: Traditional low-cost thatched roof storage structures, bottom-ventilated single-row storage structures, and modified bottom-ventilated double-row storage structures. These structures differed in the raw materials used for construction, expected lifespan, and storage losses. According to study, the maximum net profit was (75.30 %) in modified bottom ventilated double row storage structure, followed by (45.53%) in Bottom Ventilated single row storage structure, and minimum was (26.76 %) in Traditional low-cost thatched roof storage structure. Modified bottom ventilated double row storage structure is highest net return of other structures i.e. The most profitable structure regarding other structures. As the prices of onions fluctuate regularly, farmers can increase the net profit only by reducing the total storage losses and total storage cost. Sometimes even though net profit from onion storage were negative during few months, farmers were still storing the onions.

Keywords:- Onion, Onion Storage Structures, Storage Losses, Storage Efficiency.

I. INTRODUCTION

India ranks second globally in terms of fruit and vegetable production. India's horticulture production in 2023-24 according to the (1st Advance Estimates) is estimated to be about 355.25 million tonnes. In 2023-24, the production of vegetables is projected to be 209.39 million tonnes, while the production of fruits is projected to be approximately 112.08 million tonnes. In India, onion is cultivated in an area of 1.54 million hectares and production of 25.44 million MT (source: NHB, 2023-24 first advance estimate). the major onion producing states are Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana and Telangana (Ministry of Agriculture & farmers Welfare 2022-23).

Growing nearly everywhere in the nation, onions are a commodity of mass consumption. It is an essential component of every cuisine, used as both a vegetable and some spices. For this reason, it is also known to as the "Queen of the kitchen." (Selvaraj, S. 1976).

Storage plays very important role in agriculture. Agricultural products need to be stored even if farmers do not keep them in storage for future sales because their production is seasonal and their consumption is consistently distributed throughout the year. Farmers store goods on their farms for their personal consumption, to pay labourers in kind, or, in some situations, for speculative and preventative purposes. At the farm level, several storage structures are seen based on the commodity type, length of storage, climate, cost of the storage structure, the presence of rodents and insects, etc.

➤ Objective

- To estimate the cost and returns of selected onion storage structures
- To estimate structure-wise storage losses of onion storage structures
- To estimate structure-wise storage efficiency of selected onion storage structures

II. METHODOLOGY

Ahmednagar district is the state's second-largest onion-growing district in terms of both area and production. Approximately 20–22% of the state's onion production comes from the Ahmednagar district. The present study was undertaken in the Akole and Sangamner tehsils of Ahmednagar district. For this purpose, six villages from both tehsils were purposively selected based on the maximum area under onion cultivation and the large number of storage structures. Ninety storage structures were randomly selected for the study, all of which regularly stored onions. In the study area, farmers mainly used three different types of structures for storing onions, which were classified into the following three categories: Traditional low-cost thatched roof storage structures (30), bottom-ventilated single-row storage structures (30), and modified bottom-ventilated double-row storage structures (30). These structures differed in the raw materials used for construction, expected lifespan, and storage losses. The survey was conducted for the calendar year 2022-23.

Variable cost, and Fixed cost were the two categories into which the cost elements were divided. The Depreciation of structures at the rate (10%) and interest on fixed capital at the rate (12%). The variable cost that included operational cost, labours and other expenses. Actual operating cost on account of grading, packing, filling, transportation and taking out the onion from the storage structure was considered. The entire cost was calculated by adding fixed and variable cost together. Estimating depreciation was done using the straight-line method.

$$\text{Depreciation} = \frac{\text{Constructing cost} - \text{Junk value}}{\text{Expected remaining life}}$$

Calculating the storage efficiency of onion storage structure involves evaluating how well the structure preserves the quality and quantity of stored onion over time.

$$\text{Storage Efficiency} = \frac{\text{Quantity stored}}{\text{Storage Capacity}} \times 100$$

III. RESULT AND DISCUSSION

A. Cost of Storage and Storage Capacity in Different Types of Onion Storage Structure

It was observed that farmers were found to construct onion storage structures manually, utilizing mostly locally sourced materials. Three distinct types of storage structures were identified, varying in terms of cost, materials, and expected lifespan. For ease of understanding, these are categorized as: Traditional Low-Cost Thatched Roof Storage Structure, Bottom Ventilated Single Row Storage Structure, and Modified Bottom Ventilated Double Row Storage Structure.

Table 1. Cost of Storage and Storage Capacity in Different Types of Onion Storage Structure:

Sr. No.	Particulars	Traditional Low-Cost Thatched Roof Storage Structure	Bottom Ventilated Single Row Storage Structure	Modified Bottom Ventilated Double Row Storage Structure
1	Cost of construction (Rs)	25000	40000	225000
2	Length (m)	4.9	5	9.9
3	Width(m)	1.2	1.2	6
4	central height(m)	1.9	2.2	4.5
5	side height(m)	1.6	1.6	2.25
6	Storage capacity(tonnes)	5	5	25
7	Expected life (years)	6	12	20
8	Cost of Storage (Rs/kg/year)	0.83	0.66	0.45

It shown from the Table 1.the cost of storage in modified bottom ventilated double row storage structure, Bottom Ventilated single row storage structure and Traditional low-cost thatched roof storage structure is about 0.45, 0.66 and 0.83(Rs/kg/year), respectively. The bottom ventilated single row storage structure has the lowest cost, while the traditional low-cost thatched roof storage structure has the highest (Tripathi and Lawande, 2007).

B. Structure-Wise Storage Losses of Onion Storage Structure

There are two kinds of storage losses observed during onion storage, Quantitative and Qualitative losses: quantitative losses, which consist of physiological loss of weight (PLW), rotting, and scale loss, and qualitative losses, which include sprouting and black mould. Therefore, it is essential to assess both quantitative and qualitative losses based on the storage structure, as summarized in Table 2 and Table 3.

➤ Quantitative Losses of Onion Storage Structures

Table 2. Quantitative Losses of Storage Structures

Sr. No.	Storage structure	PLW (%)	Rotting (%)	Scale (%)	Total loss (%)
1	Traditional low-cost thatched roof storage structure	14.85	11.98	0.39	27.22
2	Bottom Ventilated single row storage structure	22.19	15.85	0.38	38.42
3	Modified bottom ventilated double row storage structure	24.75	17.35	0.85	42.95

When considering total quantitative losses, the Traditional low-cost thatched roof storage structure had the lowest loss at (27.22%). This was followed by the Bottom Ventilated single row storage structure at (38.42%), while the highest quantitative losses were observed in the Modified bottom ventilated double row storage structure (42.95%). The increased PLW in the Modified bottom ventilated double row structure may be attributed to a more aeration, which allowed entry of more hot and dry air in the initial months of storage. The greater incidence of rotting, which contributes to higher physiological weight losses. Additionally, variations in PLW across different years can be linked to the rainfall and humidity levels during the storage period. The year-wise differences in the physiological loss of weight may be related to the temperature and humidity condition of the particular year Which same recorded (Tripathi and Lawande, 2007; Sapkal *et al.*, 2022).

➤ Qualitative Losses of Onion Storage Structures

Table 3. Qualitative Losses of Storage Structures

Sr. No.	Storage structure	Sprouting (%)	Black Mould (%)	Total Loss (%)
1	Traditional low-cost thatched roof storage structure	1.30	1.36	2.66
2	Bottom Ventilated single row storage structure	1.96	4.35	6.31
3	Modified bottom ventilated double row storage structure	2.95	5.90	8.85

The total qualitative losses were lowest in the Traditional low-cost thatched roof storage structure exhibited the lowest total qualitative losses at (2.66%), while the Modified bottom ventilated double row storage structure had the highest, at (8.85%). Additionally, Naik *et al.* (2008), Tripathi and Lawande (2007), Sapkal *et al.*, (2022) also noted a lower incidence of black mould infection in the single row structure.

C. Cost And Returns and Profitability of Selected Onion Storage Structures

Table 4. Cost and Returns and Profitability of Selected Onion Storage Structures.

Sr. No.	Particulars	Traditional low-cost thatched roof storage structure	Bottom Ventilated single row storage structure	Modified bottom ventilated double row storage structure	Overall
1	Depreciation on structure	3695 (18.71)	3609 (11.91)	8633.4 (14.31)	5312.47 (14.98)
2	Interest on fixed capital @ 12%	443.40 (2.25)	433.08 (1.43)	1036.008 (1.72)	637.50 (1.80)
A	Fixed cost (1 to 2)	4138.40 (20.96)	4042.08 (13.34)	9669.40 (16.03)	5949.96 (16.78)
3	Human Labor	7220 (36.57)	11160 (36.84)	13700 (22.71)	10693.33 (32.04)
4	Maintenance	2483.33 (12.58)	3713.33 (12.26)	9933.33 (16.47)	5376.66 (13.77)
5	Operational cost	4110 (20.82)	8722.79 (28.80)	22787.21 (37.77)	11873.33 (29.13)
6	Interest on Working Capital @ 6%	1792.52 (9.08)	2653.76 (8.76)	4235.52 (7.02)	2893.93 (8.29)
B	Variable cost (3to 6)	15605.85 (79.04)	26249.88 (86.66)	50656.06 (83.97)	30837.26 (83.22)
	Total cost (A+ B)	19744.25 (100.00)	30291.96 (100.00)	60325.47 (100.00)	36787.23 (100.00)

(Figures in parentheses indicate percentage to total)

It would be revealed from Table 4. The highest total cost was Rs. 60,325.47 for the modified bottom ventilated double row storage structure. This was followed by Rs. 30,291.96 for the bottom ventilated single row storage structure, while the lowest total cost was Rs. 19,744.25 for the traditional low-cost thatched roof storage structure.

*D. Returns of Onion Storage Structure***Table 5. Returns of Onion Storage Structure**

Sr. No.	Particulars	Traditional low-cost thatched roof storage structure	Bottom Ventilated single row storage structure	Modified bottom ventilated double row storage structure	Overall
1	Period of Storage (Months)	2 to 3	4 to 6	5 to 6	
2	Total Cost (Rs)	19744.25	30291.96	60325.47	36787.23
3	Quantity stored (Qtl)	30	63.67	166.33	86.67
4	Storage losses (%)	27.73	38.42	42.97	36.37
5	Storage losses (Qtl)	8.32	24.46	71.47	34.75
6	Net sale quantity (Qtl)	21.68	39.21	94.86	51.92
7	Sale price (Qtl)	1243.43	2257.86	2574.96	2025.42
8	Gross income (Rs)	26958.81	55615.61	244255.55	108943.32
9	Profit (Rs)	7214.56	25323.65	183930.08	72156.10
10	Net profit (%)	26.76	45.53	75.30	49.20

In the table, the gross income is highest for the modified bottom ventilated double row storage structure at Rs. 2,44,255.55, while the lowest gross income of Rs. 26,958.81 is found in the traditional low-cost thatched roof storage structure. The highest net profit is recorded at 75.30 per cent for the modified bottom ventilated double row storage structure, followed by 45.53 per cent for the bottom ventilated single row storage structure, and the lowest net profit is 26.76 per cent for the traditional low-cost thatched roof storage structure. The table indicates that the modified bottom ventilated double row storage structure yields the highest returns and net profit, followed by the bottom ventilated single row storage structure, and then the traditional low-cost thatched roof storage structure, based on their storage capacities.

E. Storage Efficiency of Onion Storage Structure

The Table 6. illustrates that the storage efficiency of onions varies across different storage structures, with efficiency improving as the quantity of stored onions increases.

Table 6. Storage Efficiency of Onion Storage Structure (Qtl)

Sr. No.	Particulars	Traditional low-cost thatched roof storage structure	Bottom Ventilated single row storage structure	Modified bottom ventilated double row storage structure
1	Quantity stored	30.00	40.00	166.33
2	Storage capacity	50.00	50.00	250.00
3	Storage efficiency (%)	60.00	80.00	66.53

The Storage efficiency is influenced by both the quantity of onions stored and the storage capacity of the structures. The efficiency rates for the various storage types were 60 per cent for the traditional low-cost thatched roof structure, 80 per cent for the bottom ventilated single row structure, and 66.53 per cent for the modified bottom ventilated double row structure. While low-cost structures may initially seem appealing, their lower storage efficiency could result in greater financial losses over time due to spoilage or decreased quality of stored goods. More efficient structures, even if they require a greater investment upfront, can lead to better storage outcomes and increased profitability.

IV. CONCLUSION

The maximum net profit was 75.30 per cent in modified bottom ventilated double row storage structure, followed by 45.53 per cent in Bottom Ventilated single row storage structure, and minimum was 26.76 per cent in Traditional low-cost thatched roof storage structure. modified bottom ventilated double row storage structure is highest net return of other structures i.e. The most profitable structure regarding other structures.

The Modified bottom ventilated double row storage structure was popular among government suggest them; as it has more life period and average storage losses. This storage efficiency index clearly indicates that the modified bottom ventilated double row storage structure is the most effective among all the options. According to study, as price of onions fluctuate regularly, farmers can increase the net profit only by reducing the total storage losses and total storage cost.

Sometimes even though net profit from onion storage were negative during few months, farmers were still storing the onions. The profitability of storing a commodity is influenced by the price increase of that commodity during the storage period, which must exceed the actual storage costs.

POLICY IMPLICATION

- The study concludes that onion storage prices can adequately cover both storage costs and production expenses, even considering wastage. However, for this to be effective, farmers need to adjust their methods of onion storage and cultivation. As a result, it is advisable to offer training to onion growers on scientific storage techniques at the farm level.
- The government should assist the establishment of additional storage facilities at markets to ensure sales are spread out over the year, minimizing both quantitative and qualitative losses.

REFERENCES

- [1]. Anonymous, (2022-23). Department of Agriculture and Farmers Welfare (Annual Report, 2022). <https://pib.gov.in>
- [2]. Anonymous, Department of Agriculture and Farmers Welfare (Horticultural Statistical at a Glance 2021). <https://agriwelfare.gov.in>
- [3]. Anonymous, (NHB, 2023-24 first advance estimate). <https://www.nhb.gov.in>
- [4]. Brice J, Currah L, Malins A, Bancroft R (1997). Onion storage in the tropics: A practical guide to methods of storage and their selection. Chatham, UK: Natural Resources Institute.
- [5]. Chavan, V. B., Dsouza, T. F., Kokate, S. B. and Sawant, D. M., 1992. Efficacy of storage methods for minimizing the bulb rots of onion. *Maharashtra Journal of Horticulture Sciences*, 6(1):73-75.
- [6]. Deka, B. C., Sarma, D. N., Shadeque, A., Bora, G. C. and Baruah, J. N. (1995) Storage behaviour of few onion cultivars under different storage methods. *Haryana Journal of Horticultural Science*, 24(3-4): 245-250.
- [7]. Eriballo, S.G., Satheesh, N., Fanta, S.W. (2022) Performance Evaluation of Low-cost Storage Structures for Onions (*Allium cepa* L.) Storage in Bahir Dar, Amhara Region, Ethiopia. *Philippine Journal of Science* - 151 (1):437-448, February (2022).
- [8]. Iordachescu, C. S., Fuel, N., Nihailescu, V. and Turbo (1983) Studies on the possibilities of storing onions with reduced energy consumption. *Agricultural Engineering Abstract*, 8: 3.
- [9]. Kassali, R., and Idowu, E. O., (2008). Economics of onion storage systems under tropical conditions. *International Journal of Vegetable Sciences*, 13(1): 85-97.
- [10]. Maini, S. B., Sagar, U. R., Chandan, S. S. and Rajeshkumar, (1997) Evaluation of different structures for storage of onions. *Vegetable Science*, 24(1):73-74.
- [11]. Sapkal, S.B. and Gavali, A.V, (2022) Comparative economics of onion storage structures in western Maharashtra. Research Review committee meeting Report of the research work on agricultural economics, (2021-22) compiled by head, Department Agriculture Economics.
- [12]. Selvaraj, S. 1976. Onion: Queen of the kitchen. *Kisan World*, 3(12): 32-34.
- [13]. Tripathi, P.C., Lawande, K.E. (2016) Designing and evaluation of onion storage structures for Indian conditions. *International Journal of Agricultural Sciences*: ISSN 2167- 0447 Vol 6 (2): pp. 918- 924.
- [14]. Tripathi, P. C. and Lawande, K. E. 2003. Onion storage structure for small and marginal farmers. *ICAR News, A Science and Technology Newsletter*, 9(4): 18-19.
- [15]. Warade, S.D., Desale, S.B. and Shinde, K.G. (1997) Studies on storage of onion bulbs *Maharashtra Journal Agriculture University* 22 (3): 336.