सत्यमेव जयते

Nanaji Deshmukh Krishi Sanjeevani Prakalp (PoCRA)

Maharashtra Project on Climate Resilient Agriculture

(Project of Government of Maharashtra in Partnership with the World Bank)

DETAILED PROJECT REPORT

(Template)

300 MT Climate Agnostic Onion Storage Structure

Prepared as a part of

Memorandum of Understanding (MoU-IV)

Between

Nanaji Deshmukh Krishi Sanjeevani Prakalp (PoCRA)

And

Indian Institute of Technology, Bombay

2022

Project Management Unit (PMU), PoCRA

Report prepared by: Post-Harvest team at IIT Bombay

1. Mr. Nilesh Vadgave, PhD Scholar, IIT Bombay
2. Aniket Deo, Project Research Engineer, IIT Bombay
3. Mr. Prathamesh Antarkar, Project Research Assistant, IIT Bombay
4. Mr. Rajesh Ingole, Project Research Assistant, IIT Bombay

Under the supervision of: Prof. Amit Arora, Principal Investigator, IIT Bombay

For support and guidance: aarora@iitb.ac.in

Project Management Unit

Nanaji Deshmukh Krishi Sanjeevani Prakalp (PoCRA)

30B, Arcade, World Trade Centre, Cuffe Parade, Mumbai, Maharashtra 400005

Phone No.-022-22163351/52

Mail Id- mahapocra@gmail.com

Table of Contents

Table of Figures

Tables of Tables

1 Introduction

Climate change and its links with the vulnerability of food value chain and agriculture are now well established. This Detailed Project Report (DPR) presents details of Climate Agnostic Smart Integrated Onion curing and storage structure for the PoCRA region. DPR is a part of collaboration between Nanaji Deshmukh Krishi Sanjeevani Project (PoCRA), Govt of Maharashtra and Indian Institute of Technology Bombay.

2 Background

To get an idea and vision of the project, it is important to have glimpse at the background of the work that has been done till now, based on which the current project is proposed.

2.1 Overview of Onion Value chain

Nearly three quarters of Indian families live in rural India and their economy is connected with the rural income. Post industrialization of last few decades, share of agriculture in economy has declined sharply below 15%. Along with economic policies, changing climatic conditions, increased fluctuations in market of agriculture produces, increasing production costs and decreasing profits have made farming in India vulnerable. (World Bank, 2012). India is prominent producer of vegetable and fruits in the world. Production of onion in India is second highest in the world with the production of 24.4 million MT onion in 2019. India generates huge revenue by exporting onion. Despite of the importance of this agricultural commodity, there is ignorance to the losses occurring in onion supply chain and subsequent infrastructure building. (NABARD, 2017). Storage structure can play a pivotal role in changing the scenario of this gap and ensuring profits to the onion growing farmers.

2.2 CA Storage structure at CTARA, IIT Bombay

CTARA, IIT Bombay has developed Climate Agnostic (CA) storage structure to curb losses of onion during storage. In 2018, working prototype of CA storage structure was developed for performance evaluation and installed at DOGR, Pune. MOU with DOGR was signed for

continuing research in the field of onion and garlic. 100 MT CA Storage structure will be constructed at VNMKV, Parbhani by August 2022.

3 Analysis of the Onion Storage structures in PoCRA region

As a part of MoU between PMU-PoCRA and IIT Bombay, field visits in the PoCRA regions (Jalna and Aurangabad districts) were organised and extensive survey of FPO directors, farmers and private players engaged in the onion storage infrastructure was carried out. Following major issues were found which contribute to storage losses of onion (qualitative and quantitative).

1. Poor quality onion seed
2. Mixing of varieties of onion
3. Heavy and uncertain rain and exposure to direct sunlight
4. Lack of appropriate ventilation (forced)
5. Spread of rotting due to heavy stacking
6. Accumulation of dew on surface of ceiling
7. Expensive loading/unloading and sorting operation
8. Defective onion bulbs due to improper curing
9. Uncontrolled use of powder to control to prevent sprouting

Specific details of the survey are available in the report submitted to PMU-PoCRA.

3.1 Major problems faced by farmers with traditional onion storage structures

During the visit to various locations of large onion warehousing systems (500 MT and above) in Jalna district, it was found that the owner of the system has employed his own understanding along with the traditional design. It involved alterations in dimensions, materials and methods. Though it came from their own understanding of the system, little came from the advice of the experts.

Figure 3.1 Locations of visits to Onion storage facilities in PoCRA regions

Extreme rotting and sprouting of the onion: Due to unscientific design, the onion was exposed to the extreme and uncertain rain that caused direct immediate damage and later resulted in extreme rotting and sprouting of the onion. The important thing observed was that there is no designated agency to check and approve the designs for such warehouses (though some government departments like NABARD use designs suggested by ICAR-DoGR).

3.2 Important observations from visits and surveys

It was observed during the discussion that farmers were more focused on saving on initial costs of the structure than understanding the effect of design parameters on storage efficiency as well as operational costs of the storage structure. Budget constraints of FPCs, limited subsidies on storage structure, focus on more storage capacity with less investment at the cost of quality were some of the reasons for poor functioning of onion storage structures.

3.3 Comment on current government interventions for Onion storage structures

Most of the MahaOnion supported storages are running on the 'NAFED model' where risks of onion spoilage and subsequent financial loss to owner are highly reduced. Owner has to make sure that 75% of the onion stored at the start of rabi onion harvesting period (or period designated by NAFED) will be available for dispatch during the period of approximately 6 months (with intervals and quantum of each dispatch being decided by NAFED). Owner of the storage is paid a rent amount of 1.25 Rs per KG for the entire period of the storage. In case onion quantity goes below 75% (65% good quality onion and 10% average quality onion), the owner is accounted for replenishment of the onion beyond the above limit.

Though this model works well for farmers, the focus is not on reducing losses and thus 25% losses are assumed at the start. In such cases, the owner has more focus on enhancing storage capacities in order to earn more rent (profits) and the novel objective of reducing storage losses is ignored.

Major objective of NAFED behind this initiative is not to reduce losses but to stabilize prices in the market through high stocking of the onion.

3.4 Concluding remarks from the feasibility study (from phase II)

As a part of collaborative work with PoCRA, comparative feasibility study was carried out to see the efficacy of different storage solutions available in the market. Techno-economic feasibility analysis (Separately attached with the DPR) evidently speaks about the efficacy of going for controlled environment storages. Three potential storage options available in the market were compared on every technical and financial front to arrive at conclusion that choosing the CA storage structure for onions with specified capacities would help in reduction of losses during storage as well as improve the profitability of the business for FPOs working with smallholder onion grower farmers.

Considering the minimum capacities of storage structures from the profitability indicators and budgetary constraints of the project, onion storage structure of 300 MT capacity and beyond is advisable to be constructed. For detailed Techno-economic feasibility analysis, please refer to chapter *'Comparative Techno-economic feasibility analysis'*.

3.5 Scope of the project

Project is part of the MoU between IIT Bombay and PoCRA (Govt. of Maharashtra). It is limited for the FPCs operating in the PoCRA districts. There are guidelines for selection of the eligible FPCs for the project intervention. FPCs fulfilling these criteria will be chosen for the storage structure establishment.

Also, the total cost of the project is advised to limit within INR 1 Crore as subsidy of 60% does not apply for an extra cost beyond INR 1 Crore.

Project involves establishment of the Climate Agnostic Onion storage structure with the technological support and hand holding from IIT Bombay Post Harvest team and administrative and financial support from the PoCRA team.

4 Project details

4.1 Project objective

Objective of the project is to install the 300 MT climate agnostic onion storage structure developed by CTARA, IIT Bombay in order to enhance shelf life of stored onions and get better market prices during better market conditions.

4.2 Project description

Project proposes to establish an innovative climate agnostic onion storage structure in order to facilitate farmers to store their onion for extended duration (over 6 months) without undergoing significant losses. Project activities involve planning, designing and construction of the 300 MT climate agnostic storage structure and handling it over to the selected eligible farmer producer company in the PoCRA region.

There are three major strategic partners in implementation of the project. IIT Bombay team has developed the technology for climate agnostic storage structure. IIT Bombay team through MoU with PoCRA Project Management Unit has collaborated for dissemination of the technology to the farmers. PoCRA Project Management Unit extend all the financial and ground support for the implementation of the project. Farmer Producer Company is the formal legal entity which will take up this project for the execution.

4.3 Business plan

Following Business Model Canvas shows different activities associated with the proposed business and is helpful tool visualise the overall structure of the proposed business activities.

Problem	Solution	Unique Value Proposition	Unfair Advantage	Customer Segments
• Huge losses in Onion Storage • Less prices to farmers in peak harvesting time • High onion prices to customers in high demand season	• Controlled conditioned Storage to reduce Losses • Advanced Technologies to track and reduce losses in value chain	• Climate Agnostic Storage system • Integrated Curing facility along with storage • Well Ventilated stacking system	• Medium scale and Indirect Network effect	**Producer's end:** Small and medium landholder farmers (Individual) Onion processing FPCs Government Departments (NABARD, PoCRA etc.) **Consumer's end :** Institutional Buyers Retailers (Vegetable shops)
	Key Metrics • No. of buyers connected • No of member farmers Connected • Losses prevented during storage		**Channels** • APMC direct selling • Year round contracts with Institutional buyers	
Cost Structure **Major Costs:** Product Manufacturing and Developing, Setting up distribution Channels			**Revenue Streams** • Direct Selling • Ownership • Partnership (Year round Contracts)	

Figure 4.1 Business model canvas for Climate mate agnostic Onion storage structure

5 300 MT Climate Agnostic Onion Storage Structure

300 MT capacity onion storage structure is the storage facility developed by CTARA, IIT Bombay. This storage structure involves air tight enclosure, internal stacking system for onion and air handling system for precise control of the internal atmosphere.

5.1 Features

Following are the salient features of the climate agnostic onion storage structure developed by CTARA, IIT Bombay

5.1.1 Curing and storage at specified atmospheric conditions

CA storage structure integrates curing as well as storage of onions. Curing is performed on freshly harvested onion to make them ready for storage. Curing process involves uniform and steady heating of onion to maintain the curing temperatures. Here, air with uniform

temperature, relative humidity and air flow rate is allowed to interact with onion bulbs in a controlled fashion. Artificial curing duration differs from 48 hours to 96 hours depending on the variety of onion and their initial conditions.

Figure 5.1 Photograph depicting the 3D visualization of the 300 MT CA storage structure

5.1.2 Scientific design of stacking system

Stacking system is backbone of the storage ecosystem as it defines the flow of material and associated costs and manpower. CA storage consist of stacking system with optimum strength and also worker friendly. The cost-effective design facilitates air to flow in streamlined manner throughout the storage structure and allow workers to interact with the system in safe and secure manner.

5.1.3 Semi-Automated loading and unloading operation

Storage structure has internal stacking system which has specially designed bin arrangement with the consideration of ventilation needs and integration of stacking system with conveying system. Motorised conveyor system allows fast and precise loading of onion into the bins and unloading of onion out of bins. Complementary equipment like sorting and grading machine can be attached to this conveyor system for further efficient sorting and grading of the onion.

5.2 Plant Layout

Following given plant layout depicts the land area needed to construct and run the storage facility smoothly. Main storage facility requires 342 Sqm floor area where overall land area

required is 1082 sqm. All the necessary considerations and assumptions are already explained in the assumption section. The storage facility includes main storage area, staging area, store room, office and control room, space for weighing bridge (load cells), loading/unloading vehicles and buffer area for safety and security reasons.

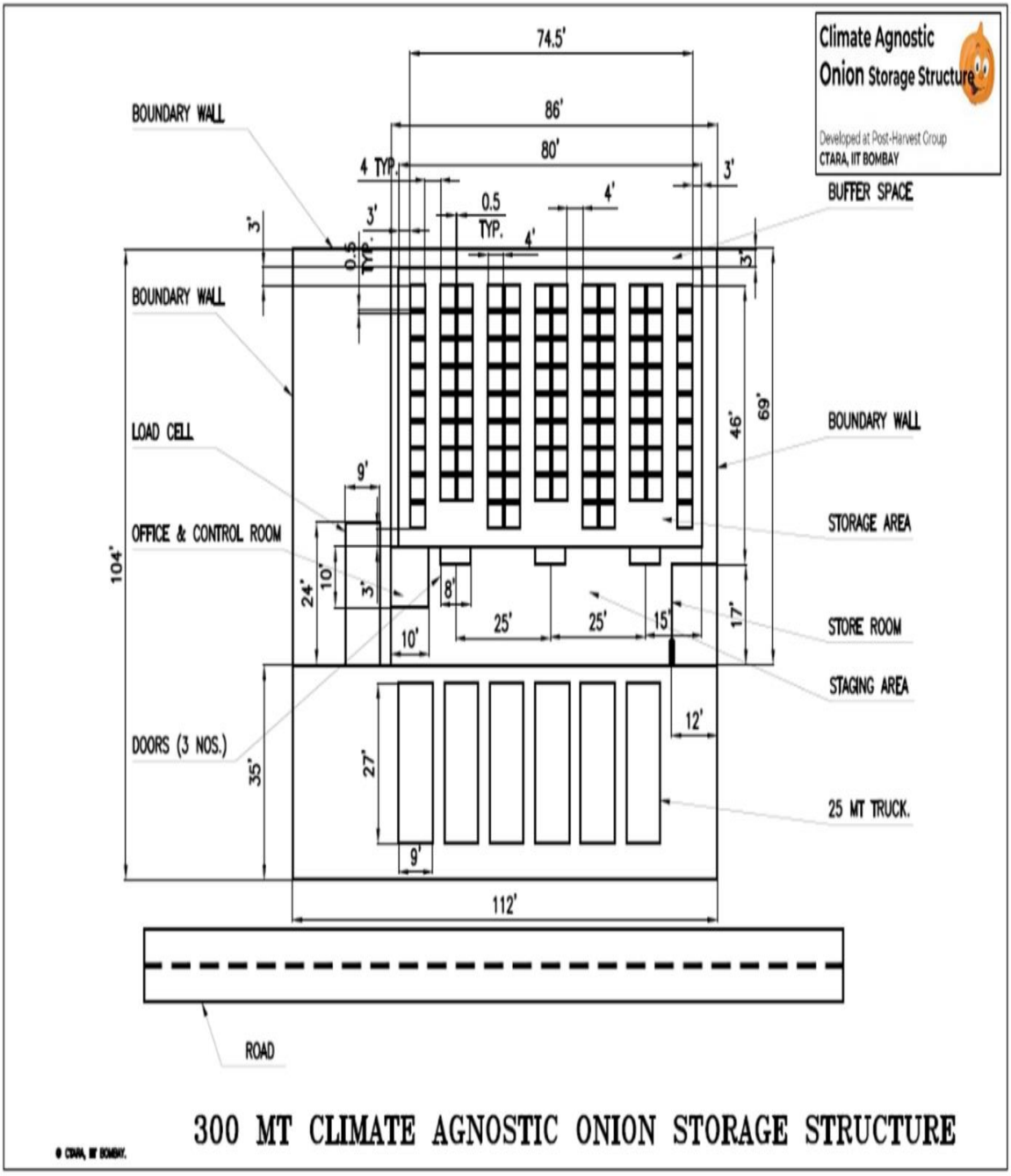

Figure 5.2 3D visualization of 300 MT Climate Agnostic onion Storage structure

5.2.1 Specifications and other details of the project

Following are given the space requirement for the project. It consists of three main areas, Main storage space, foundation flooring space which includes staging area and buffer space and finally the overall are involving loading spaces, weigh bridge, office space etc.

Particulars	Specifications (ft)	Area (Sq ft)	Area (Sqm)
Main Storage	80' X 46' X 17'	3,680	342
Foundation flooring	86' X 69' X 2'	5,934	551
Surrounding Area (Overall)	**112' X 104'**	**11,648**	**1,082**

Following general assumptions are considered while developing the project,

1. Land ownership- FPC owns the land and no separate money needs to be paid for the land acquired for the construction of the climate agnostic storage structure.
2. Connectivity to the main road- lands is not too far from the main road or no separate costs incurred for developing the basic infrastructure (road and electricity supply)
3. There is continuous supply of 3 phase electricity to operate the storage structure equipment and necessary documentation and permissions (formal commercial/industrial electricity connection to the storage site) will be completed by the FPC.
4. At least 80% of the members of the FPC are involved in the cultivation of onion and procurement of onion is done from these members.

5.3 Capital Investments

Following are the details of costs incurred as a capital investment. It includes taxes and contingencies involved in the setting up of CA onion storage though it does not consider supervision costs.

Table 5-1 Capital costs (INR) associated with construction of CA storage structure*

Capacity (MT)	**300**
Specifications	**80'*46'*17'**
Enclosure (A)	**22,46,480**
Panel	10,74,091
Ceiling	9,92,575
Door	1,79,814
Air handling System (B)	**11,75,000**
Evaporator and condenser	7,00,000
Heating	1,00,000
Damper and Exhaust fan	1,75,000
Installation	2,00,000
Civil construction works (C)	**6,50,000**
Stacking fabrication and Installation (D)	**17,01,000**
Conveyer + Weighbridge (E)	**11,50,000**
Total 1 (A+B+C+D+E)	**68,72,480**
Total with 18% GST (F)	81,09,526
Contingency @10% (G)	6,87,248
Total 2 = Total 1 + F + G	**87,96,774**
First season Operational cost (H)#	5,35,000
Total 3 = Total 2 + H	**93,81,774**
Final Total rounds up to	**94,00,000**

*Cost figures subject to change depending upon market fluctuations

Working capital 60% of the working costs of one season

5.3.1 Onion as a raw material

Commodity to store in the storage structure is onion. Though, we have considered rabi onion as the only commodity to be stored in the storage facility for the comparative analysis, kharif onion as well as other perishable agricultural commodities (fulfilling the storage structure's criteria) can be stored to utilize the full potential of the storage facility. Onion varieties that are grown in the PoCRA region and are the focus of the project for rabi season are Bhima shakti, Bhima Kiran and Bhima Super. In most cases, other varieties are also used. It is assumed and advisable to use uniform onion seed by the member farmers which would add to effectiveness of storability of onion. Details of the costs associated with the onion and price fluctuation analysis is discussed in subsequent sections and annexure.

5.4 Operational expenses

Climate agnostic smart onion storage structure focuses on effective utilization of labour to reduce the drudgery involved in the process. Loading, unloading and sorting equipment provided will help reduce the operational costs associated with the manual labour and also reduce the time required for the loading/unloading operation. Following are the details of the operational costs and man power involved in the day to day operations.

5.4.1 Operating costs and respective manpower required

Major role of air handling equipment is to keep the quality of atmosphere inside the storage structure within the acceptable range. Analysis of daily usage of system throughout the duration of storage is given below. For the purpose of simplicity of calculations, numbers are round off to nearest integers.

Table 5-2: Daily usage of system

Month	No of hours
May	6
June	8

July	10
August	10
September	8
October	6
Average	8

Table 5-3 shows the specifications of the conveyor system being used for loading/unloading process. It also denotes the usage and specific costs associated with it.

Table 5-3: Specifications of the conveyor system

Conveyor capacity	Amount	MT/day
Rating	5	HP
Efficiency	80	%
Power consumed	4.6	Kw
Daily usage	12	Hrs
units utilised	56	Units/day
Electricity charges	10	Rs/unit
Amount	480	Rs/day
Frequency of usage	40	Days/season

Table 5-4 summarises the details of man power required for the smooth operation of the storage facility.

Table 5-4 Details of the operational costs associated with CA storage structure

	Particulars	Amount	Unit
1	**Electricity**		
	Storage Capacity	Up to 325	MT
1.1	Power rating of the equipment	23	KW
1.2	Units consumed per season	35,460	Units/season
	Electricity cost per season	3,54,000	Rs
2	**Human Resource (for 1 season)**		
2.1	Security person	1,00,000	Rs
2.2	Facility operations head	1,72,000	Rs
2.3	Conveyor system expenses	57,000	Rs
2.4	Labours	42,000	Rs
2.5	System maintenance	30,000	Rs
	HR Sub Total	4,21,000	Rs
3	**Other (Office expenses)**	1,40,000	Rs
	Total	**8,95,000**	Rs

6 Financial analysis of the 300 MT CA Onion storage structure

Considering the scale at which CA storage structure gives considerably good returns and budgetary constraints of FPCs and subsidy available, 300 MT storage structure will be a suitable capacity for the project.

6.1 Assumptions

Following assumptions are made based on the data from the field and the literature available.

a. *Worst case scenario:* Losses in the IITB storage structure have been observed to be in the range of 10-12% during field experiments. For the purpose of analysis, the losses are considered to be 20% which then accounts the ground level uncertainties (various causes of poor storability those we discussed in the first chapter). On the other hand, losses for other traditional storage facilities have been reported to be in the range of 35% to over 60%. These values have come out from the field surveys, interviews and literature. Minimum losses at 35% happen only when all the critical factors (Appropriate and timely rain, supporting weather conditions, resilient seed variety and appropriate harvesting practices) are under acceptable limit. So, the losses value of 35% and 30% has been considered for the 'MahaOnion' and 'TaTa Steel storage structure.'

b. *Procurement and Selling prices:* Though, rigorous analysis of APMC data has been carried out to find the modal prices and its variance, there is significant gap in the data on available from the web portal (agmarket.gov.in) and the data collected directly from the field. Using the understanding of the both sources, values of selling price and procurement price is set to be 20Rs/Kg and 8 Rs/Kg.

c. *Capital and operational costs for different capacities of storages*

   Three potential storage structures have been shortlisted for the analysis. Specific capacities (100MT, 300MT, 500MT and 1000MT) have been considered for the analysis. In reality, all the three storage structures are not available in all the capacities. To calculate their respective capital costs and operational costs, base of 1000MT storage structure is used and other values are calculated via extrapolation. Care has been

taken to consider the costs associated with the standard parts as well as shared costs (economy of scale).

6.2 Scenario A: Without Subsidy

Two cases are presented, one without any government subsidy and other with the subsidy. This is purposely done to see the dynamics of the business associated with the CA storage structure facility. Sensitivity analysis and scenario analysis is also carried out to see the important factors affecting the profitability of the CA storage structure.

6.2.1 Parameters for the financial analysis

Table 6-1 Assumption for financial analysis of 300 MT CA Storage structure

Particulars	Amount	Unit
Procurement Cost	8	Rs/Kg
Selling price	20	Rs/Kg
Discount Rate	10	%
Inflation rate	4	%
%Loan	75	%
Loan interest rate	10	%
Subsidy	0	Rs

6.2.2 Bifurcation of Costs

Table 6-2 Bifurcation of costs for 300 MT CA storage structure without subsidy scenario

Particulars	Amount (in Rs)	%
Capital Investment	94,00,000	100
Subsidy	0	0
Loan	70,50,000	75
Self-investment	23,50,000	25

6.2.3 Outcomes of case without Subsidy

Table 6-3 Outcomes of financial analysis for 300 MT CA storage without subsidy scenario

Net Present Value (INR)	55,02,160
Internal Rate of Return	18%
Discounted Pay Back Period	11
Benefit Cost Factor	0.59

From the results of the analysis, it can be observed that project intervention is profitable at the scale of 300 MT. But, payback period (discounted) is very high for the intervention. From the sensitivity analysis shown in graph given below given, it is clear that BCR and hence profitability is highly dependent upon the selling price, capital investment and storage losses. Though selling price is the external factor and depends on the market situation, capital

investment is the area where support can be provided to improve the profitability of intervention and to make it sustainable.

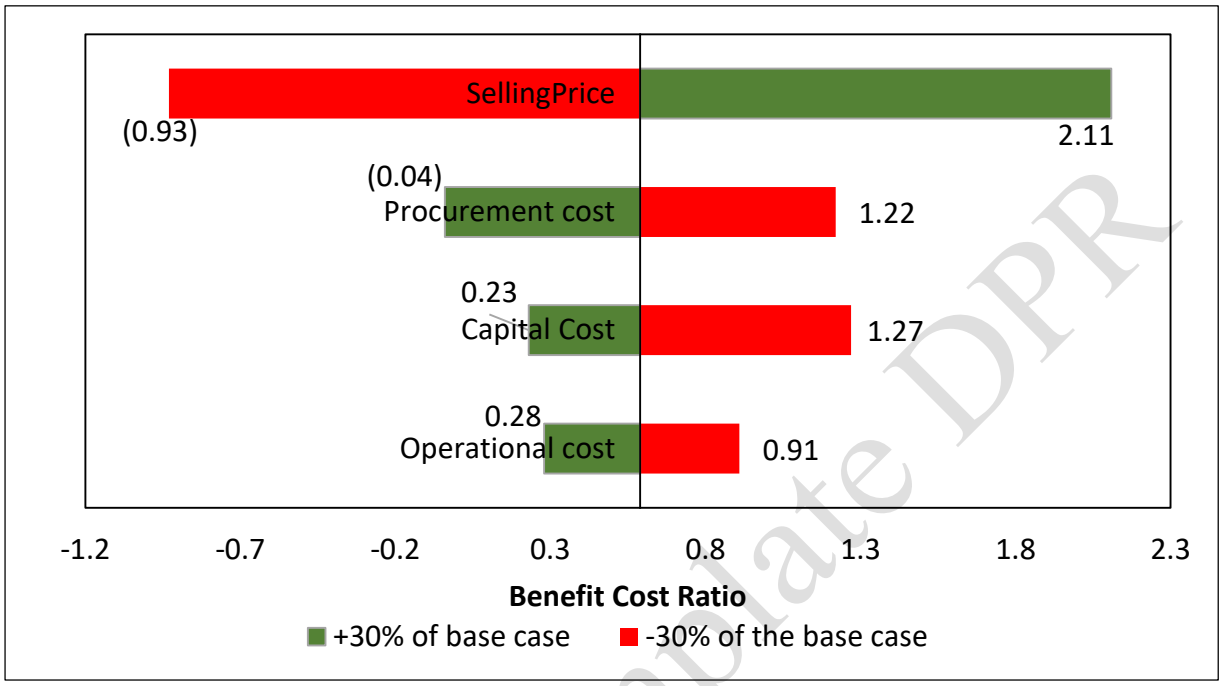

Figure 6.1Sensitivity analysis for 300 MT CA storage structure for BCR

Sensitivity analysis of the 300 MT storage structure (without subsidy) is carried out in order to study the effect and its weightage of each parameter in the benefit Cost Ratio. These four parameters are selling price, Procurement cost, Capital cost and the operational cost.

Most sensitive parameter comes out to be the selling price which is also the most vulnerable one as per the previously done price analysis. Selling price depends primarily on the keeping quality of onion. Precise control of storage conditions would result in better quality of the onion and will help achieve the highest range of selling prices.

6.3 Scenario B: With Subsidy

6.3.1 Parameters for the financial analysis

Table 6-4 Assumptions for 300 MT CA storage structure for with subsidy scenario

Particulars	Amount	Unit
Procurement Cost	8	Rs/Kg

Selling price	20	Rs/Kg
Discount Rate	10	%
Inflation rate	4	%
%Loan	75	%
Loan interest rate	10	%
Subsidy	60	%

6.3.2 Bifurcation of Costs

Table 6-5Bifurcation of costs for 300 MT CA storage structure for with subsidy scenario

Particulars	Amount (in Rs)	%
Capital Investment	94,00,000	100
Subsidy	56,02,225	60
Loan	28,51,112	30
Self-investment	9,33,704	10

6.3.3 Outcomes of case without Subsidy

Table 6-6 Outcomes of financial analysis for 300 MT CA storage for with subsidy scenario

Net Present Value (INR)	1,11,04,385
Internal Rate of Return	46%
Discounted Pay Back Period (years)	4.7

Benefit Cost Factor	2.97

Here, it is now clearly evident that CA storage structure is profitable even at very conservative parameters, so it will definitely be going to give better results in the real-life scenario. Further, providing subsidy support will further enhance the financial gains to the FPC.

6.4 Summary of Scenario analysis

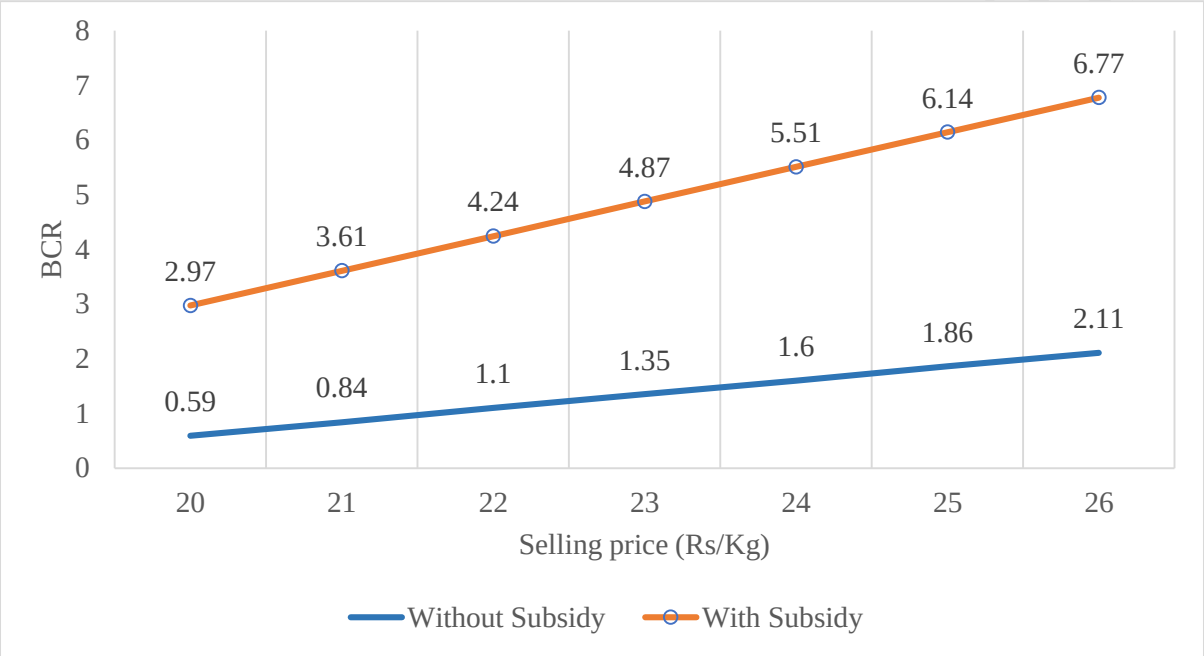

Figure 6.2Comparison of BCR for 'with' and 'without' subsidy scenario at various selling prices

Above shown graph shows the comparison of Benefit Cost Ratio for both the cases. As selling price of onion increases, BCR for storage structure begins to improve. Minimum BCR of 1 is always advisable for business to be viable. Subsidy plays an important role to achieve BCR more than 1 even in most conservative cases.

Figure 6.3Comparison of DPBP for 'with' and 'without' subsidy scenario at various selling prices

One of the major parameters to be taken into consideration is payback period. Above graph compares both the cases for discounted payback period. Subsidy helps to bring down the payback period and even at the most conservative selling price ranges.

6.5 Project viability

The first thing to keep in mind while understanding the results of the financial analysis is that the values of selling prices used while doing it are very conservative and hence it depicts the *worst-case scenario* implications in the result. As we have seen in the price analysis, selling prices of onion goes up to Rs.35/Kg (where we have considered it to be Rs. 20/kg). Also, Procurement cost goes down to Rs. 6/Kg (where we have considered it to be Rs 8/Kg). The Internal Rate of Return (IRR) of the project is 48.6% which are significantly higher than the average rate of returns by bank which is about 10%. Analysis of BCR ratio under various conditions revealed that project is viable even for the 180 days of operation. Storage structure can be used for storage of kharif onion as well as other suitable agricultural commodities which would give bonus returns to the farmers.

Hence, the project is financially viable. The NPV of the project is positive at a discount factor of 10% during the period of operation considered. This implies that the project generates sufficient funds to cover all its cost, including loan repayments and self-investments and interest payments during the period.

Subsidy entitlement

Since total capital investment requirement is about 94 lakh rupees, eligible FPCs can apply under PoCRA program for maximum a subsidy of 60 lakhs or 60% (depending on the proposal) for the project.

6.6 Project implementation

The key factors that would facilitate successful and timely project implementation are:

- Selection of capable and eligible Farmer Producing Company
- Selection of contractors for civil construction and erection of CA storage structure.
- Training and skill building of FPCs and employees to operate the storage system.
- Establishment of an efficient system for project planning & monitoring including reporting procedures for progress review & co-ordination.

6.7 Implementation Schedule

After acceptance of DPR (principally), procedure for selection of FPC and location can be done. After initial approval for starting, the construction of the Storage structure, actual work will start within two months (based on payment procedures and documentation involved). Final quality check and handing over the storage structure to FPC will take another one month.

6.8 Forward & Backward linkage

6.8.1 Backward linkages

Farmer Producer Company with majority of onion growing farmers as its members will be given a priority. Here, owner of the storage structure will themselves be the major suppliers of the onion.

Onion farmers will be acting as a client of the FPC as well as its shareholders. So, FPC can procure onion from member farmer via three major modes

a. Direct purchase of onion through prior contracts (Least risk to farmer members)

Through this model, onion will be procured right from farm gate of the farmer and farmer will be paid fixed pre decided price. Freshly harvested onion will then be a responsibility of the FPC. Price slabs for the procurement and guidelines to be followed can be made in consultation with the board of directors and facilitating agency.

b. Rental scheme for onion growers (Least risk to FPC)

In rental scheme, farmers will keep their freshly harvested onion for curing and storage and then will pay weekly or monthly rent for the duration of the storage. Final selling decision will then be taken by farmer members (owner of produce) in consultation with the CEO and BODs. All the guidelines for rental model will be finalised after consultation with facilitating agency, FPO and funding agency.

6.8.2 Forward linkages

Major objective of the project is to enhance the shelf life of onion and to provide benefit to member farmers and to help stabilise the market fluctuation of onion in the retail market. Having said this, forward linkages and respective marketing channels can be designed in several ways.

Few of the potential options for the forward linkages are

a. Direct selling in the APMC

This is traditional way of doing business. After storage duration gets complete and market rates starts reaching peak rates in the season, FPC can directly sell the onion to traders through APMC. Also, direct contracts with the traders from the non-onion producing regions can be developed to sell the onion at competitive rates with decent profit margins.

b. Institutional contracts (B2B)

Though 300 MT seem to be very large quantum, if we check the quantum of daily consumption of onion in any urban institution, it won't be difficult to establish

institutional linkages through year-round contracts. These institutions can be the big educational institutions with residential facilities, restaurants, and canteens of the companies.

These institutions also face the uncertainties of onion prices. Also, they lack the proper storage facility for such big quantum of the onion. Considering this problem as an opportunity to establish contracts with the institutional buyers is a win-win deal. A fixed rate for purchase can be set (with proper profitability analysis with help of facilitating agency). Such contracts will help FPC to reduce uncertainties involved in the businesses and help develop good networks.

6.9 Government Policy related to onion storage structures

There are various state and central government schemes for setting up the traditional onion storage structures. Nanda Kasabe of Financial Express has put a light in some of the major schemes of government in regard to onion storages. Following are given few excerpts from her analysis.

The government has allocated a grant of 60 crore to farmers for developing onion chawls (warehouses) for storage of the commodity under the Rashtriya Krishi Vikas Yojana (RKVY) 2019-20. The central government's scheme is aimed at enhancing the storage facilities in the state so that farmers are not forced to sell their produce in distress and retain the commodity until the market conditions improve. Around 6,500 farmers from 28 districts in Maharashtra, who have developed onion chawls or open onion storage structures will be eligible for the grant given by the government.

According to the experts in the industry, the scheme which falls under the National Horticulture Mission (NHM) gives a grant of 50% on the construction of a 25 MT chawl, which have to be properly ventilated structures with proper storage. Normally, a 25 MT storage capacity chawl requires an investment of 1.75 lakh, of which a 50% subsidy is offered to onion farmers for setting up such structures.

The 27th State Level Project Approval Committee had given the green signal for setting up onion storage structures across Maharashtra in the wake of the price volatility and to prevent farmer from distress sale. Around INR 150 crores will be spent on the project and accordingly, the government has approved INR 60 crores within a year. The scheme envisages 50% of the funds to be invested by the farmer and the remaining 50% would come from the government in the form of a grant.

Meanwhile, MahaFPC-the apex body of farmer producer companies in Maharashtra, has signed tripartite agreements with 16 farmer producer companies in the state and NAFED to develop a value chain for onion procurement, storage and disposal . This is a joint project proposed by NAFED and MahaFPC with contribution of 25 FPCs in the state to execute a Public Private Partnership (PPP) Integrated Agriculture Development (PPP-IAD) project under the Rashtriya Krishi Vikas Yojana (RKVY-RAFTAAR) for building storage capacities for onion and setting up marketing infrastructure. This 25-crore project will see the government investing 50% while the rest will be raised by NAFED and FPCs.

The project will enable FPCs to remove monopoly of traders in onion markets. The project envisages building storage infrastructure for 25,000 MT of onion in the state wherein each FPC will establish a cluster on a 1-1.5-acre land parcel for 1,000 tonne each. Each cluster will be set up for 1 crore where 20% of the investment will come from the FPC (from around 100 farmers in each FPC), 25% from NAFED, 5% from MahaFPC and the remaining funds from the state government under the RKVY scheme.

6.10 Market potential & marketing strategy

Following bar graph shows the production of onions since 2007-08. Being a cash crop, onion has been attracting farmers who invest their money and land in hope of good prices. Production in last few years has tremendously increased and now has passed the domestic requirement which has worsened the condition.

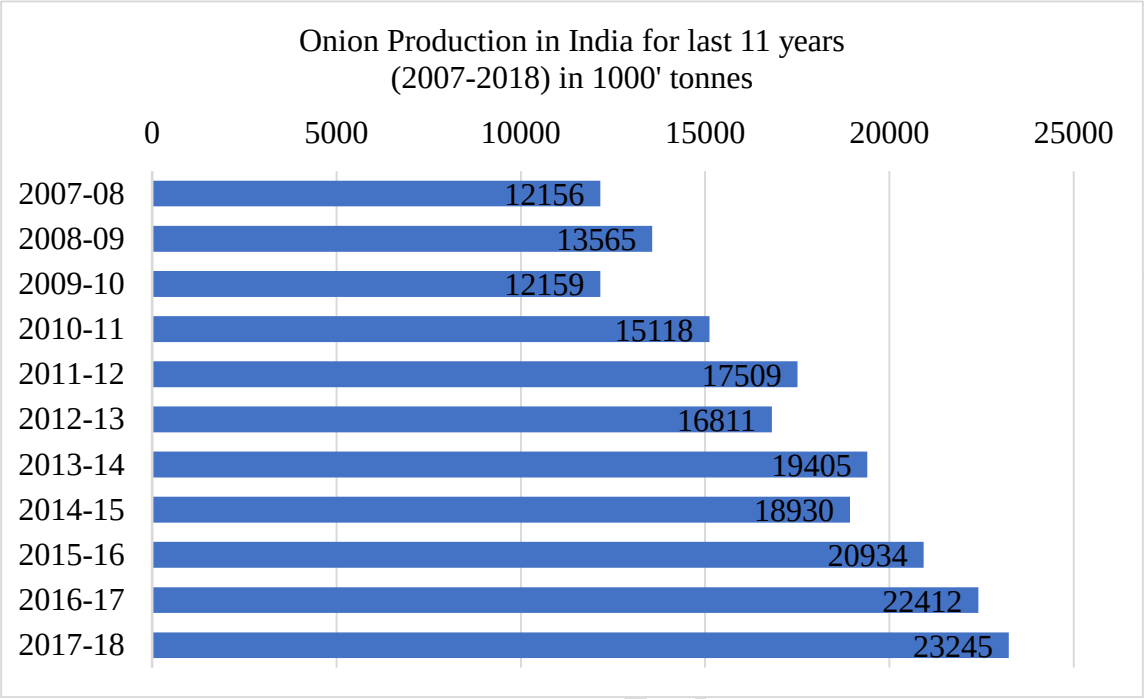

Figure 6.4Onion production for last 11 years

Year 2019 witnessed huge fluctuation in prices of onion all over the country. Heavy and uncertain rain causes arrivals of onion in market to decline and then prices of onion shoot up dramatically. Researchers and scientists have written much on this issue but due to the complexity of the problem, the issue has remained unsolved. According to FAO, India produces 230 lakh MT of onion, out of that 200 lakh MT gets consumed domestically (and some part goes into export). Government subsidised storage system only provides 4.3 lakh MT capacity (NABARD, 2017). Due to lack of infrastructure, this additional onion cannot be stored and comes into market which bring down prices in wholesale and retail markets.

Agricultural Development and Rural Transformation Centre- Institute for Social and Economic Change published a report on onion and its price variations. Analysis in the report showed that poor and marginal farmers are bearing loss in cultivation of onion every year due to increase in per hectare cultivation prices and uncertain fall in market prices. In the survey of farmers, along with the issue of good quality of seeds, farmers chose poor refrigeration facility and infrastructure for onion which is also the major concern.

6.11 Costs associated with the onion (Analysis of literature and field data)

Several studies have been done which proposes different cultivation or production costs for the onion. (BARAKADE A.J.1, 2011) in his paper says that cultivation prices for onion are more in rabi than in kharif season. Onion production cost contains land preparation cost, nursery cost, manure cost, pesticide, irrigation, harvesting, curing, and loading and transportation costs. In the study, it was found that onion production costs for onion growing farmers in Maharashtra is Rs. 3.97 per Kg. Though this study was conducted and published in 2011 and production has increased tremendously in last 10 years. Study conducted by ADRTC-ISEC came out with the onion production prices ranging between Rs. 6.5 per kg to Rs.15.5 per Kg for farmers having different land holdings. It is evident from the above two studies that onion production prices vary according to region, variety and type of onion grower and their economic conditions.

6.12 Trends in onion wholesale prices

Following table summarises the wholesale prices of onion at Pune APMC for the last 10 years. For our analysis of financial viability, we have considered procurement cost at Rs 8/kg and Selling price at Rs 20/kg. This is the real situation if see at procurement cost of Rs 8.3/Kg in April 2021 and selling price of Rs 20.1/Kg in October 2021 (highlighted cells with yellow colour)

Table 6-1 Average modal prices for onion at Pune APMC

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Mar	4.9	3.7	7.9	6.7	9.9	7.0	5.5	6.4	4.3	13.9	12.7
Apr	4.8	4.1	7.2	7.7	9.2	7.3	5.4	5.5	5.9	14.1	8.3
May	5.0	4.3	8.2	8.8	12.0	7.7	4.5	5.3	7.7	9.5	10.1
Jun	7.0	5.4	12.4	15.1	16.4	9.5	6.3	8.6	11.7	6.8	13.7
Jul	8.3	6.1	17.4	17.3	24.0	9.5	7.3	10.1	12.5	6.7	13.3
Aug	9.7	6.6	35.4	15.3	44.5	7.9	19.0	9.7	17.8	9.1	12.5
Sep	9.9	6.3	37.8	14.5	47.0	6.7	14.2	7.5	25.6	19.4	12.5
Oct	8.6	7.8	34.5	13.7	38.1	6.5	22.0	10.7	18.4	26.8	20.1
Nov	8.5	10.6	30.5	14.0	33.9	9.7	29.8	10.4	28.6	29.8	17.5
Dec	6.6	12.5	12.9	14.2	16.5	9.1	20.9	7.5	50.2	20.1	18.7
Jan	4.2	11.4	8.1	11.8	15.0	6.5	17.7	5.7	27.8	21.1	17.9
Feb	3.5	11.0	5.2	11.8	9.0	6.0	12.0	3.7	17.3	26.8	16.9

Table 6-2Average maximum prices for onion at Pune APMC

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Mar	6	5	11	9	14	9	6	13	6	19	18
Apr	6	5	10	10	13	9	6	8	9	17	12
May	6	6	11	12	17	13	6	8	11	12	15
Jun	9	7	18	21	22	11	9	11	14	9	20
Jul	10	8	23	25	25	11	9	14	14	9	20
Aug	12	8	41	22	48	9	23	12	20	13	18
Sep	13	8	43	21	50	8	18	11	32	29	18
Oct	11	10	40	20	40	8	27	15	34	44	32
Nov	12	15	34	20	38	12	38	14	64	49	28
Dec	9	18	16	21	20	11	37	10	95	29	32
Jan	6	17	11	17	17	8	29	8	40	30	30
Feb	5	15	7	17	11	7	17	6	21	38	28

Source: Agmarket.gov.in

Now to get idea of how conservative and realistic our analysis is, let have look at market data shown in the table. If we see at the modal prices of onion for months April and May, we can see that for almost all years (except 2015 and 2020), prices were below Rs 8/Kg. On the other hand, if we see the modal prices in the month of September and October, we could see that these values (with some years as exception due to market dynamics) are well above Rs20/Kg and reach up to Rs 34/kg in some cases.

Similarly, if we see average of maximum prices, we get better understanding. Of course, after precise storage of onion for 4 to 6 months, FPC get better chances to tap the top 10% price slab for selling their stored produce and can easily do business in safe zone.

6.13 Social and environmental risks and impacts

As the storage structure does not consist of any synthetic chemicals in its operational, it does not cause any health hazards. Also, it only stores onion and does not do any primary or secondary processing, it does not involve any alteration to its composition.

6.14 Contribution to the Sustainable Development Goals

The project is intended to reduce huge losses that occur during the storage of onion through an appropriate technological intervention. It helps to reduce food wastage at the pain points in the value chain. Also, through participatory approach, it ensures the profitability as well as sustainability of the onion cultivation practice.

SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

SDG 12 talked about reducing food wastage and make it accessible to masses at affordable prices. Project intervention aligns itself with the SDG2 to make Onion value chain resilient.

SDG 13: Take urgent action to combat climate change and its impacts

Target 13.1 exclusively states to “Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries”.

Onion has been vulnerable to climate change and its ill effect on the environment. Making Storages agnostic to such hazards will save farmers from the financial blows and subsequent effects on their overall development.

6.15 Expected results and impact

After completion of the project, major expected outcomes of the project are,

a. Reduction in the wastage of onion by a significant amount compared to the solutions available in the market and enhance the quality and shelf life of onion.
b. Contribution towards 'Doubling farmers' income' initiative by the government
c. Resilient supply chain through the strong backward and forward market linkages
d. Contribution to national targets of Sustainable Development goals related to climate, food and Technology nexus
e. Empowered co-operative institutions and boosting rural entrepreneurship with appropriate technology dissemination

6.16 Conclusion

The Detailed Project Report (DPR) document covers all the necessary details pertaining to the project including background of the problem, insights from baseline survey, comparative feasibility analysis of the solutions available in the market and finally the financial and viability analysis of the project.

Setting up the 300 MT capacity climate agnostic onion storage structure would be the appropriate intervention considering the financial and operating capabilities of FPCs and subsidies available for such interventions.

Climate agnostic storage structure has capacity to provide assurance of justifiable return to the small holder onion grower farmers and also contribute to government's policies to reduce losses in the value chain.