Model Scheme

On

Fish Cold Storage

NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT

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1. Introduction

India is the second largest producer of fish in the world after China and accounts for nearly 6% of global fish production. The fish production in India is likely to cross 12 million tonnes by 2015 from the current level of about 9.3 million tonnes.

India's seafood industry has become one of the leading suppliers of quality seafood to all the major markets of the world. India has world class seafood processing plants that follow quality control regimes complaint to stringent international regulatory requirements. The export earnings in 2013-14 had reached an all time high of US $ 5 billion (about Rs.30213 crore). *Vannamei* shrimp, black tiger shrimp, cuttlefish, lobster, clams, fish fillets and squid are the major products for export.

With the growing demand for Indian seafood products across the world, the dynamics of the seafood business in India is changing fast. There is a tremendous growth in the resources and infrastructure of the Indian seafood industry today.
The country has an installed processing capacity of 18,520 M.T with 447 state-of-the-art processing plants, out of which 60% are EU approved plants. Almost every plant has put in HACCP and Quality control system on par with the best in the world to ensure highest quality output.

There is a huge scope for investments in marine fish processing sector, cold storages and export of coastal fish for the private sector as it holds vast, untapped marine resources with a great export potential.

2. Fish Cold Storages

Once fish is frozen, it must be stored at a constant temperature of −23 °C (−10 °F) or below in order to maintain a long shelf life and ensure quality. A large portion of fresh fish is water. Because the water in fish contains many dissolved substances, it does not uniformly freeze at the freezing point of pure water. Instead, the free water in fish freezes over a wide range of temperature, beginning at approximately −2 °C (28 °F). The amount of remaining free water decreases until the product reaches a temperature of approximately −40 °C. Fish held below that temperature and packaged so as not to allow water loss through sublimation can be stored for an indefinite period. Unfortunately, there are relatively few commercial freezers capable of storing fish at -40° because of the tremendous variation in energy costs. Fish are therefore

normally stored at −18 to −29 °C (0 to −20 °F), resulting in a variable shelf life ranging from a few weeks to almost one year.

The International Institute of Refrigeration recommends a storage temperature of -18°C for lean fish such as cod and haddock and -24°C for fatty species such as herring and mackerel.

3. Technical requirements of cold storages

3.1 Criteria for selection of Cold storage site

The site for location of the cold storage has to be selected carefully taking into consideration the following factors :

- Nearness to processing centre is of paramount importance for getting frozen products in adequate quantities.
- Uninterrupted power supply.
- Easy accessibility for free flow of raw material and finished product.
- Adequate supply of fresh water.
- Availability of skilled and unskilled labour

3.2 General Layout

A production cold store is usually a part of the fish processing plant for storing frozen finished products. Bulk cold stores normally give the same service as production cold stores, but are often located at some distance from the actual processing industries and are normally much larger than the production stores which cater to the needs of other processing plants also for storing frozen sea foods on custom hiring basis.

Capacity of cold stores normally ranges between 1,000 MT and 10000 MT. However, the size of the cold store depends on a number of factors like amount of traffic, average storage period, number of articles, as well as the number of clients.

Cold stores can be either single-storey or multi-storey buildings. Now a days, multi-storey cold storages are built only in congested or costly land areas and those buildings are normally not more than two storeys high.

A single-storey cold store can be easily designed to meet the specific requirements of stacking and handling equipments. Wall and roof

constructions can be made lighter as they do not have to support the weight of the product stored, as in a multi-storey building.

A single-storey building can have a relatively simple layout. Depending on size, it can either have one single room or it can be divided into a number of rooms. Normally all the rooms are operated at the same temperature for fish preferably in the range of -20° to -24°C. Most stores, with the exception of small prefabricated ones, are built at a higher level than the surrounding yard with a special loading ramp at one or more sides. The loading ramp level corresponds to the height of the most commonly used vehicles.

The engine room should be as close as possible to the position of the air cooling equipment within the store. This sometimes poses a problem in the planning of future extensions and it may therefore be placed at the end of the cold store in such a position that it will easily serve future expansion. Alternatively, the engine room can be placed away from the cold store complex and serves the air cooler via a pipe bridge so that extensions can take place in any direction.

3.3 **Construction Methods**

Modern large or medium cold stores are built as one-storey buildings designed for mechanical handling, e.g., forklift trucks and automatic stacker cranes. Manual handling is, however, still used for most small-sized stores.

A cold store can be built as an ordinary building using conventional building material, such as bricks, concrete or concrete process sections to which a vapour barrier and insulation is fitted internally. Now a days, polyurethane is used for panel designs suitable for all sizes of cold rooms. Imported factory made insulation panels are delivered to the site complete with a vapour barrier and internal cladding, thus reducing the site work to a minimum. The panels normally used in these systems are either polyurethane or polystyrene insulated panels with or without frames. They are manufactured as sandwich panels, one face being the vapour barrier of light-gauge galvanised steel sheet and the other face being the internal finish of plastic-coated galvanised sheet or aluminium sheet. A decorative external cladding is erected on the outside of the columns. The roof insulation is constructed as a suspended ceiling. The roof panels are, in principle, the same as the wall panels, but are sometimes equipped with wooden frames.

The wall panels are fixed to the columns or horizontal rails between the columns with special bolts. The joints are sealed with tape or sealant mastic and

the internal joints are finished with a cover strip. The roof panels are hung from the outer roof construction with hanger rods and locked together with sealed, tongued and grooved joints or similar. For the roof panels, special care must be taken where the hanger rods pass through the vapour barrier. In humid climates, ventilation might not be sufficient to avoid condensation in the attic space above the insulated ceiling. This problem can be overcome by closing the space and drying the air with some form of air drier.

In the case of single-storey cold stores, two types of frame work are commonly employed. Metal frameworks, can span distances up to 60m without the need for internal columns. They are prefabricated in the factory and transported to the site in sections for quick and easy erection. The minimum span is approximately 15m. Minimum load is involved as the roof frame is carrying only the waterproof covering and the insulation. In some designs it also carries the weight of the air coolers within the room. Then it is desirable to concentrate these loads near the columns rather than at mid spans. An outside metal framework can be used for electrical earthing connections.

Reinforced concrete frameworks can incorporate concrete beams spanning the room, or can be a combination of concrete columns supporting metal trusses. Overhead rail systems can be supported from the main structure or a separate steel frame can be incorporated inside the cold store with separate columns transferring the load onto the main structural floor.

3.4 Insulation

The choice of insulation is very important as it accounts for a large proportion of the total construction cost. The insulation material and thickness is also important from an energy point of view. Besides the insulation material should also be odour-free, anti-rot, vermin and fire-resistant and impermeable to water vapour. Some of the most common materials are Polystyrene, Styrofoam FR and Polyurethane.

The final quality of any insulation is not only a matter of the properties of the material itself, but of the way it is erected or fitted to the external building. Heat bridges should be avoided, e.g., those normally created by pipes, cable joints, etc. Piping which carries low pressure refrigerant or other liquids at low temperature must be insulated. The provision of an efficient vapour barrier on the outside of the finished insulation with joints properly sealed is of utmost importance, as moisture vapour penetrating the insulation will form ice and gradually destroy the insulation material. The thickness of insulation depends

upon the internal temperature, heat conductivity of the insulation material and the dew point of the ambient air. The insulation material should be protected against moisture and mechanical damage. Where uncovered insulation material is used, the internal walls and ceiling can be protected by sheets of aluminium, galvanised steel, reinforced plastic, etc., or with materials such as plaster and cement. The choice of material should be related to the use of the store, e.g., need for washing down. Painting of plastered walls is not recommended unless special paint is used as it will quickly peel off.

The insulation of the cold store doors should be the same standard as the store wall. The most common insulation material for doors is polyurethane and door heaters should be fitted to prevent ice forming at the seal thus jamming, and ultimately causing damage to the door.

3.5 Vapour barriers

The air within a cold store holds a good deal less water vapour than the air outside. Water vapour in the air gives rise to a pressure and together with the other gases present, such as oxygen and nitrogen, account for the atmospheric pressure. The partial pressure exerted by the water vapour is proportional to the quantity of vapour present and the vapour in the air will tend to migrate from areas of high partial pressure to areas of low partial pressure. Hence, there is a tendency for moisture in the ambient air to pass through the insulation of a cold store to the area of low partial pressure within store. When this vapour is cooled, it condenses and at the point where the temperature is 0°C, it freezes to form ice. This process will continue over a long period of time and the build-up of ice will eventually affect the insulation properties of the cold store wall and also weaken the structure of the wall or building. Unfortunately, the outward effects of this build-up of ice may not show for some time, long after the builder's guarantees have become invalid.

To prevent this type of destruction to the store insulation, a vapour barrier has to be provided on the warm side of the insulation. This vapour barrier must be complete and cover all walls, the roof, ceiling and the floors. For stores constructed against a building wall, this may be formed by applying at least two coats of a suitable bituminous sealing compound. With prefabricated stores, a vapour barrier is already provided with the individual sections, usually an outer facing of sheet metal, and only the joints require sealing.

Foundations and frost heave : Low temperature stores built directly on the ground may require special precautions to prevent the build-up of ice below

the cold store floor. The ice formation causes distortion known as "frost heave" and in particularly bad cases, it can lead to the complete destruction of the store and structure of the building. Two methods of preventing frost heave are commonly used. The ground below the store can be heated either by a low voltage electrical mat in the cold store foundation or by circulating a heated liquid such as glycol through a pipe grid built into the foundation. Another method of preventing frost heave is to leave a space below the store for ventilation. The additional height required for this facility leaves plenty of height for an air ventilation space below the insulation. This ventilation arrangement should be clearly defined and not blocked at a later date when the main function of the air space has long been forgotten.

The provision of a vapour barrier and the prevention of frost heave are probably the two most important requirements in the construction of a cold store.

Air ingress : Outside air entering the store adds heat and moisture. This moisture will be deposited as frost on any cold surface and will eventually finish up on the surface of the cooler. Excessive air exchange should be prevented to keep the cold store temperature steady and reduce the frequency of defrosting.

A curtain of air blown downward or from the side of the doorway can reduce the exchange of air when the door is open. Store door openings can be fitted with an inner curtain made from overlapping strips of synthetic material suitable for use at low temperature. This reduces the air exchange considerably without interfering too much with traffic but the curtain must be maintained in good order.

Large stores are fitted with power-operated doors which can be quickly opened and closed, usually by automatic vehicle sensor or pendant switches outside and inside the doorway. Because this system is easy to operate even from a moving fork lift truck, door opening times are kept to a minimum.

3.6 Floors

The ground loads from a cold store are in the order of 5500-8000 kg/m^2. This consists of static loads due to merchandise, structure and concentrated rolling loads transmitted by forklift trucks and other handling equipments. It is of importance that those loads are investigated in detail for each special project.

In the case of a single-storey building, a reinforced raft is usual, including ground beams at the edges or bases for the structural frame. This can rest directly on the existing ground or a supported slab.

The floor wearing surface requires particular care. Most commonly the floor wearing surface is a concrete slab cast on the floor insulation with a thickness of 100-150mm. In cases where intensive traffic is foreseen a special hard wearing top-finish is recommended. Before casting the wearing surface, the floor insulation should be protected by bituminous paper or plastic sheeting. Special attention must be given to floor joints. If the joints open too much after lowering of the temperature, they must be filled with a suitable jointing compound.

3.7 Product handling and storage room (Ante Room)

In hot countries, handling frozen fish outside the low temperature storage space can quickly result in exposed fish being warmed and even thawed. The provision of a refrigerated working area and loading dock is therefore recommended for pre storage sorting and the assembly of loads for shipment. This loading dock should be totally enclosed, insulated and refrigerated. The area of this dock will depend on the amount of traffic and the type of store operation. In a public store where a good deal of sorting is required, this area may be much as 25 percent of the store floor area.

Large stores are provided with a loading platform which can be adjusted to accommodate varying vehicle heights. This platform must also provide adequate space for quick sorting and maneuvering of goods in and out of storage. A platform width of 8 to 10m may be necessary for this purpose. The unloading area should also be roofed over so that goods being transferred in and out of the store are protected from direct sunlight and rain.

3.8 Refrigeration

The capacity of the refrigeration plant must be based on a thorough heat load calculation for each individual project. Refrigeration load can vary widely for stores of the same capacity depending on design, local conditions, product mix, etc. The refrigeration equipment should conform to requirements laid down in national codes of practice, insurance companies, as well as international recommendations.

Most large cold stores are equipped with 2-stage ammonia refrigeration installations. For smaller plants, usually less than 6000 kcal/h refrigeration

capacity, approved refrigerant will probably be used in single stage systems operating with thermostatic expansion valves.

The refrigeration system should be designed for high reliability, and easy and proper maintenance. Once a cold store plant has been pulled down in temperature, it is expected to maintain this temperature, literally, forever. Even maintenance jobs that need carrying out only every 5-10 years must be taken into consideration.

3.9 Types of cold stores

Stores with unit coolers: The most widely used method of cooling modern cold stores is by means of unit coolers with fan designed with good circulation of the air. This type of cooler is generally the cheapest to install; it contains a relatively small charge of refrigerant, it can be readily defrosted without interfering too much with the store conditions and it does not require a heavy structure for support. However, the main disadvantage is that many designs using this type of cooling unit do not allow for uniform distribution of the air within the store. By suspending the unit cooler from the ceiling or installing the unit outside the store and ensuring that pallets are stacked with suitable head space and floor spacing, uniform air distribution can be achieved.

Multiple units: Multiple units are usually better than large single units for a number of reasons. A multi-unit system gives some insurance in case of breakdown. The cold store can usually be maintained at its design value without the need for all units to be in operation provided there is not a high additional refrigeration load due to product and heavy traffic in and out of the store. Multiple units also allow each unit to be defrosted in sequence and this arrangement has the least effect on storage conditions. If a hot gas defrost system is used, then a multiple unit system is essential so that the units in use provide the necessary refrigeration load for the refrigeration compressor.

3.10 Cold-Air Distribution

The air in a cold room essentially transfers heat by convection. The actual cooling is effected by two main types of heat exchangers, natural convection coils and forced-air coolers. Natural convection coils have the advantages of maintaining high relative humidity and low air velocities, but these advantages are offset by disadvantages like difficulties of defrosting. Forced-air circulation enables greater refrigeration capacities because of high rate of heat transfer. It

also gives a more even temperature distribution within the room. Forced air coolers can be mounted inside the cold store space or placed in an external compartment with air circulation by means of fans through a delivery duct. Forced-air coolers are usually built as a single small unit, including the fan which is easily mounted within the room itself. The equipment is often combined with special air ducts for even air distribution in the room. The advantages of this type of equipment are reduced installation costs and easy maintenance.

3.11 Defrosting

When the refrigerant temperature is lower than -3°C, frost will deposit on the coils and this results in a reduction in the heat exchange. Regular defrosting is of great importance in the operation of a cold store. There are a number of methods available, such as hot-gas defrosting for direct expansion systems, water defrosting and electric defrosting. Sometimes combinations of these methods are employed, e.g., hot-gas defrosting followed by water spraying or hot-gas defrosting of coils with electric tray heating. The latter is now the most used in new installations. Other developments include sensors which measure the frost deposit at specific locations on the cooler fins, the air flow reduction due to frost build up or the refrigerant temperature differential across the cooler. They may be linked to a timer to ensure that auto defrosts do not occur during high refrigeration load period.

3.12 Equipments used

A list of some of the equipment that may be considered for use in cold storage is given below:

i. Platform trolleys (manual or self propelled)
ii. Manual or self-propelled pallet trucks
iii. Belt, chain or roller conveyors, either gravity or self-propelled.
iv. Elevators of various types
v. Cranes
Hand-stacking equipment
vi. Mechanised stacking equipment
vii. Fork lift trucks (hand or power operated)
viii. Adjustable mechanised conveyors

As far as possible, pallets should be used for storage of product. These divide the goods into unit loads which can be transported, stacked and retrieved with

a minimum of effort. Regular-shaped packages or blocks can be readily palletised.

Pallets should not be stacked so that the base of one pallet rests on the produce below except in the case of frozen blocks of fish or where the product cannot be crushed. In large stores, pallet racks have been motorized so that there is no need to provide so many passages within the store. The racks are moved as required to allow access to individual rows.

When a fully accessible palletised system with rack is not used, the product should be loaded in the store so that a first-in first-out system can be operated. This ensures that there is a correct product rotation, and storage times are not unnecessarily long.

The width of passageways will depend on the equipment used for transporting and stacking the product. Details of the space requirements of this equipment must therefore be obtained before a decision is made on the size of store required.

When products are placed in the cold room it is important that an air space is left between the product and the ceiling, the floor and the external walls otherwise heat entering the store through the insulation will pass through the produce before being transferred to the cooler. Between the product and the floor the air space is automatically provided by the construction of the pallet.

4. Manpower requirements

The cold storage operations are not very labour intensive. Product transport and stacking inside3 the cold store is done mechanically using equipments such as trucks and stackers. Manual labour is required only for loading and unloading. Other manpower requirement includes Manager, Supervisor, Accountant, Technician and Watch man. Details of manpower requirements of cold storages of 1000 MT, 2000 MT and 3000 MT capacities are given in the table 1 below:

Table 1
Manpower requirements of cold storages

Particulars	1000 MT			2000 MT			3000 MT		
	No.	Salary/ month	Total Salary	No.	Salary/ month	Total Salary	No.	Salary/ month	Total Salary
Manager	1	15000	18000	1	20000	240000	1	25000	300000
Supervisor				1	15000	180000	1	20000	240000
Accountant	1	8000	96000	1	8000	96000	1	10000	120000

Office Assistant				1	8000	96000	1	10000	120000
Technician	1	8000	96000	2	16000	192000	2	20000	240000
Helper	1	5000	60000	1	5000	60000	1	5000	60000
Security	1	5000	60000	1	5000	60000	2	10000	120000
Casual Labourers	5	50000	600000	10	100000	1200000	16	160000	1920000

5 Tentative implementation schedule

The construction of cold store and erection of machinery and trial run may take maximum five months after sanction of loan. Details given in the table 2 below.

Table 2
Tentative Implementation Schedule

Particulars	Time line
Project preparation	1 month
Application and sanction of loan	2 months
Completion of civil work and placement of orders for machinery	4 months
Installation of machinery	1 month

6. Financial Viability and Bankability

6.1 Project Cost

The main costs involved are preparation of the site, construction of the building, engine room equipments, machinery, electrical installation, other equipments and services. These costs will depend to a great extent on the location of the site. The cost of construction of 1000 MT, 2000 MT and 3000 MT capacity including land cost and machinery and other equipments works out to Rs.175 lakh, Rs.395 lakh and Rs.600.50 lakh respectively. The above costs are average indicative costs. Banks may adopt higher or lower than the average costs depending on local conditions and viability of the units. Details given in Annexure II.

6.2 Means of Finance

Financing to fish processing falls under priority sector lending. The loans to units meeting the criteria of MSME are classified under MSME sector. Such units can be financed by any scheduled commercial banks, Regional Rural

Banks and Cooperative Banks. While submitting the project to the banks for sanction of loan, entrepreneurs are expected to submit detailed project report with plan and estimates for all the civil works to be undertaken as also invoices of various items to be purchased from the suppliers.

7. Terms and conditions of financing Cold storage units

7.1 Borrowers profile

Complete details of the entrepreneurs, viz. individual, partnership firm or registered company, qualification and experience of the promoters, net worth of the borrowers, other activities undertaken by them etc. have to be furnished.

7.2 Margin Money

The promoters of the units need to bring their margin as per the requirement of financing banks and also as per RBI guideline issued from time to time. The margin money varies from minimum 10 per cent to 25 per cent of project cost. We have assumed margin money of 25 per cent in this model scheme. The rest of the cost of development will be provided as bank loan.

7.3 Bank Loan

The promoters of the units can approach any financing bank for finance. In most of the Government supported subsidy schemes, it is compulsory to take bank loan to avail subsidy. Therefore, the promoters should be careful in deciding means of finance. Bank loan of 75 to 90% of the total cost of development shall be available from the financing institution. Bank loan considered in this model is 75%.

7.4 Rate of interest

Banks are free to decide the rate of interest within the overall RBI guidelines issued from time to time. However, the ultimate lending rate has been considered as 13 % for working out the bankability of the model project.

7.5 Rate of refinance

NABARD refinance is available for setting up of cold storage unit provided the same is technically feasible and financially viable. In view of priority attached to exports, NABARD is agreeable to provide refinance as per existing norms.

7.6 Security

As per RBI guidelines, the banks are required to take adequate security for the loans extended by them. The borrowers should plan projects in such a manner that they have enough fixed assets to offer as security against bank loan. Banks are guided by RBI guidelines issued from time to time in this regard.

7.7 Grant & subsidy

There are numbers of incentive from Sate Governments for promotion of food industry. Some of the states have formulated their Agro Industry Policy. Various incentives are available depending upon the activity from District Industries Centres (DIC). Ministry of Food Processing Industry, Central Government is implementing a centrally sponsored scheme known as National Mission on Food Processing (NMFP) jointly with State Governments. The scheme will be operational during 12th Five Year Plan. Subsidy is available under this scheme for various purposes under food processing industries. GoI has appointed State Nodal Agencies for implementing this scheme in different states. Details of these schemes are available in the respective web sites/offices of the government departments/agencies.

7.8 Working capital

The main costs for operating a cold store include labour and refrigeration energy. The cost of labor is dependent on specific business operations, but generally more labor is required as inventory increases. Banks sanctioning term loan for setting up the unit should also make arrangements for availability of working capital loan to enable the borrower to run the unit smoothly. Working capital requirements of the requirements of cold storages of 1000 MT, 2000 MT and 3000 MT capacities are given in the table 3 below:

Table 3
Working Capital Assessment for cold storages

(Rs. Lakh)

Particulars	**Cost**		
	1000 MT	**2000 MT**	**3000 MT**

Electricity charges	30	45	72.0
Wages	6.0	12.0	19.20
Salary	4.92	9.24	12.0
Repair & Maintenance	5.0	8.0	10.0
Miscellaneous	6.0	10.0	12.0
Total	**51.92**	**84.24**	**125.2**

7.9 Financial Analysis

The detailed calculation of project's income and expenditure has been indicated in **Annexure III, IV and V.** Financial results such as IRR, NPW, BCR and DSCR for all the models are positive. Details are given in **Annexure VI**. Summary is given below:

Estimated Financial Indicators

Financial Indicators	**Estimated**			**Requirement**
	1000 MT	**2000 MT**	**3000 MT**	
NPW @ 15 % DF	253.8 lakh	577.6 lakh	869.89 lakh	Should be +ve
IRR	42%	50%	49%	Above 15%
BCR	2.4:1	3:1	3.1:1	Should be above 1.0
DSCR	2.2	2.1	2.0	Should be above 1.5

7.10 Repayment period of loan

The repayment period works out to years including 6 years including one year grace period for repayment of principal.

Annexure I

Assumptions for working out economics of cold storages

1. Capacity utilization: 90% during peak season (August to December) 60% during lean season

2. Average capacity utilization – 70%

3. Capacity utilization in first year – 40%

4. Rent charges – Rs.50 per pallet per day.

5. Interest on working capital considered at 14% per annum and interest on term loan considered at 12% per annum.

6. Depreciation @10% on civil structures and 13.9% on machinery have been considered for calculations.

7. Margin money considered at 25% of the financial outlay.

8. Repayment period of six years with one year grace period has been considered.

Annexure II

Project cost

(Rs. Lakh)

No	Particulars	Cost					
		1000 MT		2000 MT		3000 MT	
		unit	Cost	unit	Cost	unit	Cost
A	A. Cost of land including land development	0.50 acre	25.00	0.75 acres	37.50	1 acres	50.00
B	Cost of construction & machinery						
	Cold store including electrical installation, office, generator room, compressor rooms etc.	1800 m2	63.00	3500 m2	122.50	4500 m2	157.50
	Pallets,	1000 nos.	6.0	2000 nos.	12.00	3000 nos.	18.00
	Racks	16 nos.	24.00	50 nos.	75.00	100 nos.	150
	Stacker	1	10.00	1	10.00	1	10.00
	Reach Truck	1	25.00	2	50.00	3	75.00
	Refrigerator unit	2	30.00	5	75.00	8	120.00
	Generator	1	5.00	1	10.00	1	15.00
	Miscellaneous		2.00		3.00		5.00
	Total (B)		165.00		357.50		550.50
	Grand Total (A+B)		**190.00**		**395.00**		**600.50**
	Total Cost considered for bank loan (including 10% land cost)		167.50		361.25		556.50

Annexure III

Economics of 1000 MT fish cold storage

(Rs. Lakh)

No.	Particulars	1st year	2nd year	3rd year	4th year	5th year	6th year
A	Capacity utilisation	40%	70%	70%	70%	70%	70%
B	**Revenue**	**72**	**126**	**126**	**126**	**126**	**126**
C	**Cost of Production**						
i	Electricity charges	15.00	30.00	30.00	30.00	30.00	30.00
ii	Salaries & wages	5.46	10.92	10.92	10.92	10.92	10.92
iii	Repairs & Maintenance	5.00	5.00	5.00	5.00	5.00	5.00
iv	Miscellaneous	3.00	6.00	6.00	6.00	6.00	6.00
	Total cost	**28.46**	**51.92**	**51.92**	**51.92**	**51.92**	**51.92**
	Profit before interest & depreciation	43.54	74.08	74.08	74.08	74.08	74.08
	Interest on Term Loan	14.82	14.82	11.86	8.89	5.93	2.96
	Depreciation	20.20	17.64	15.41	13.47	11.77	10.30
	Profit before Tax	8.52	41.62	46.82	51.72	56.38	60.82
	Income-tax @ 20%		8.32	9.36	10.34	11.28	12.16
	Profit after tax	8.52	33.30	37.45	41.38	45.10	48.65
	Cash Accruals	28.72	50.94	52.86	54.84	56.88	58.95
	Repayment of Term Loan		22.80	22.80	22.80	22.80	22.80
D	Cash acruals + interest on term loan	43.54	65.76	64.72	63.74	62.80	61.92
E	Repayment of Term loan & interest	14.82	37.62	34.66	31.69	28.73	25.76
F	DCSR (D/E)	2.94	1.75	1.87	2.01	2.19	2.40

Average DSCR - 2.2

Annexure III (a)

Calculation of IRR, BCR & NPW of 1000 MT fish cold storage

(Rs. Lakh)

Particulars	**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**
Capital cost	190					
Revenue	72	126	126	126	126	126
Cost of production	28.46	51.92	51.92	51.92	51.92	51.92
Net income	-146.46	74.08	74.08	74.08	74.08	74.08

IRR	42%
Present worth of benefit	429.89
Present worth of cost	176.09
NPW	253.80
BCR	2.4

Annexure IV

Economics of 2000 MT fish cold storage

(Rs. Lakh)

No.	Particulars	1st year	2nd year	3rd year	4th year	5th year	6th year
A	Capacity utilisation	40%	70%	70%	70%	70%	70%
B	**Revenue**	**144.00**	**252.00**	**252.00**	**252.00**	**252.00**	**252.00**
C	**Cost of Production**						
i	Electricity charges	22.50	45.00	45.00	45.00	45.00	45.00
ii	Salaries & wages	10.62	21.24	21.24	21.24	21.24	21.24
iii	Repairs & Maintenance	4.00	8.00	8.00	8.00	8.00	8.00
iv	Miscellaneous	5.00	10.00	10.00	10.00	10.00	10.00
	Total cost	**42.12**	**84.24**	**84.24**	**84.24**	**84.24**	**84.24**
	Profit before interest & depreciation	101.88	167.76	167.76	167.76	167.76	167.76
	Interest on Term Loan	35.23	35.23	28.18	21.14	14.09	7.05
	Depreciation	44.50	38.79	33.83	29.51	25.76	22.50
	Profit before Tax	22.15	93.74	105.75	117.11	127.91	138.22
	Income-tax @ 20%	4.43	18.75	21.15	23.42	25.58	27.64
	Profit after tax	17.72	74.99	84.60	93.69	102.33	110.57
	Cash Accruals	62.22	113.78	118.43	123.20	128.09	133.07
	Repayment of Term Loan		54.20	54.20	54.20	54.20	54.20
D	Cash acruals + interest on term loan	97.45	149.01	146.61	144.34	142.18	140.12
E	Repayment of Term loan & interest	35.23	89.43	82.38	75.34	68.29	61.25
	DCSR (D/E)	2.77	1.67	1.78	1.92	2.08	2.29

Average DSCR **2.1**

Annexure IV (a)

Calculation of IRR, BCR & NPW of 2000 MT fish cold storage

(Rs. Lakh)

Particulars	**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**
Capital cost	395					
Revenue	144	252	252	252	252	252
Total cost	**42.12**	**84.24**	**84.24**	**84.24**	**84.24**	**84.24**
Net income	-293.12	167.76	167.76	167.76	167.76	167.76

IRR	50%
Present worth of benefit	859.78
Present worth of cost	282.18
NPW	577.60
BCR	3.0

Annexure V

Economics of 3000 MT fish cold storage

(Rs. Lakh)

No.	Particulars	1st year	2nd year	3rd year	4th year	5th year	6th year
A	Capacity utilisation	40%	70%	70%	70%	70%	70%
B	**Revenue**	**216**	**378**	**378**	**378**	**378**	**378**
C	**Cost of Production**						
i	Electricity charges	36.00	72	72	72	72	72
ii	Salaries & wages	16.05	31.2	31.2	31.2	31.2	31.2
iii	Repairs & Maintenance	5.00	10	10	10	10	10
iv	Miscellaneous	6.00	12	12	12	12	12
	Total cost	**63.05**	**125.2**	**125.2**	**125.2**	**125.20**	**125.2**
	Profit before interest & depreciation	152.95	252.80	252.80	252.80	252.80	252.80
	Interest on Term Loan	54.26	54.26	43.41	32.56	21.71	10.86
	Depreciation	69.68	60.61	52.74	45.90	39.97	34.82
	Profit before Tax	29.01	137.93	156.65	174.34	191.12	207.13
	Income-tax @ 20%	5.80	27.59	31.33	34.87	38.22	41.43
	Profit after tax	23.21	110.34	125.32	139.47	152.90	165.70
	Cash Accruals	92.89	170.95	178.06	185.38	192.87	200.52
	Repayment of Term Loan		83.47	83.47	83.47	83.47	83.47
C	Cash acruals + interest on term loan	147.15	225.21	221.47	217.93	214.58	211.37
D	Repayment of Term loan & interest	54.26	137.73	126.88	116.03	105.18	94.33
	DCSR (C/D)	2.71	1.64	1.75	1.88	2.04	2.24

Average DSCR 2.0

Annexure V (a)

Calculation of IRR, BCR & NPW of 3000 MT fish cold storage

(Rs. Lakh)

Particulars	**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**
Capital cost	600.5					
Revenue	216	378	378	378	378	378
Total cost	**63.05**	**125.20**	**125.20**	**125.20**	**125.20**	**125.20**
Net income	-447.55	252.80	252.80	252.80	252.80	252.80

IRR	49%
Present worth of benefit	1,289.66
Present worth of cost	419.77
NPW	869.89
BCR	3.1

DISCLAIMER

The views expressed in this model project are advisory in nature. NABARD assume no financial liability for anyone using this project report for any purpose. The actual costs and returns will have to be taken on a case by case basis considering the specific requirements of projects.